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THE PRACTICAL TEACHER

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VOL. XX No. 9

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A MONTHLY MAGAZINE AND REVIEW FOR THE SCHOOL-ROOM AND THE STUDY

Vol. XX. No. 9. MARCH, 1900. Price 6d.

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THE ELEMENTS OF SCHOOL HYGIENE.

BY ARTHUR NEWSHOLME, M.D., F.R.C.P. (LOND.),

President of the Incorporated Society of Medical Officers of Health; Examiner in State and Preventive Medicine to the Universities of London and Oxford.

AT the request of its editor, I have undertaken to write for THE PRACTICAL TEACHER a series of articles giving the main principles and their application (or, in other words, stating the science and art) of School Hygiene. In essential principles school hygiene does not differ from general hygiene, and the teacher who has made himself conversant with the latter ought to be able to apply these principles to the details of school life. School life, however, presents special difficulties in the application of the laws of health, and it is therefore necessary to consider hygiene applied to school life as a speciality. This is not surprising when we remember that in schools large masses of children are aggregated in close contiguity to each other—thus greatly facilitating the spread of infection or contagion from scholar to scholar, increasing the difficulties of properly warming and ventilating the schoolrooms, as well as the initial difficulties of construction which will enable light, warmth, and air to be supplied in sufficient quantities and of a wholesome quality. It may be urged that the same difficulties arise in connection with other large aggregations of people, as in churches and theatres. This is true, and in these also the application of the laws of health in a satisfactory manner is a difficult and an expensive matter. The difficulty and the expense are such, and the attention of the architect is in many instances so concentrated upon questions of beauty and ornamentation, that the weightier matters of healthy ventilation are neglected or ignored. This has been so marked in the past, that a well-known American divine is reputed to have said that he regarded the fact that architects of the type just mentioned died quietly in their beds as a good proof of a future existence in which rewards and punishments would be meted out! Happily, many of our best architects now appreciate the importance of ventilation of public buildings, and devote almost as much time and skill to it, in considering their plans, as its importance deserves. In many instances they are not responsible for the terribly defective ventilation which is subsequently found in the buildings designed by them. When the estimates for a new public building are given, it is a common experience to find that they exceed anticipations. Then comes the process of "cutting down expenses;" and ventilating appliances, being largely hidden work, unfortunately are often abandoned, rather than unnecessary external ornamentation. The attendance at ill-ventilated and overheated theatres is responsible for many headaches and for much general *malaise*, the causes of which frequently escape detection. Did preachers realise that a certain share of the drowsiness, yawning, and lack of attention which they cannot but notice, is caused by the vitiated air breathed by their victimised hearers, rather than by the soporific effect of their discourses, we might hope for great improvements in connection with the ventilation of churches. But the evil effects of ill-ventilated theatres and churches are small compared with those of ill-ventilated schools. In schools it is the young who are chiefly affected, in the former the middle-aged and old—children suffering much more promptly and severely than adults from the effects of atmospheric impurities. There is a further fact: youth is the age for infectious diseases,

Next Month:

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With Portrait of the New President.

such as measles, scarlet fever, and diphtheria; and the deficient ventilation which characterises so many of our schools renders the spread of these diseases more rapid and complete than it would otherwise be. Middle-aged people do not escape from attacks of these diseases to the large extent which we know to be the case simply because they have suffered from them in early life, and have thus purchased their immunity. Even those who have not previously had an immunising attack suffer with comparative rarity from any of the three diseases named above after youth has passed. Every additional year of life appears to confer a small proportion of additional immunity, rendering it less likely that the person exposed to infection will prove to be a suitable soil for its development. This is a sufficient answer to those wise (?) mothers who think it a good thing, when one child is attacked with measles, to put the other children with the patient, in order "that they may get it over." Such a policy endangers the life of the children thus experimented upon, endangers their future prospects of health if they recover from the acute attack, and creates fresh foci of disease endangering the health of the community. On the contrary, if a child can be prevented from taking an infectious disease until he has reached the age of seven years, or, still better, if he can be prevented until his eleventh year, two things happen: (*a*) he is now much less likely to catch the infection, even though exposed to it; and (*b*) even though he does develop the disease, his prospects of recovery are much greater than they were at the earlier age. The first point is clearly proved by statistics which it is not necessary to quote. The second point is so important that I venture to quote actual figures based on experience of an epidemic of measles, and to express the wish that the true significance of these figures could be brought home to every mother in the country. If this could be done, we should hear less of the careless exposure of young children to infectious diseases which is now common. Experience has shown that out of every 1,000 attacked with measles at all ages, 61 die. The fatality varies greatly at different ages. Thus, in infancy (under one year of age) 96 succumb out of every 1,000 attacked; in the second year of life, 197 out of every 1,000 attacked; in the third, 102; in the fourth, 49; in the fifth, 15; and at ages five to ten, 11 out of every 1,000 attacked.

Nothing could more eloquently bespeak the importance of preventing the contact of children—particularly of those under four years of age—with infection than the preceding figures. It is clear, furthermore, that the chief danger to life involved in the spread of infectious diseases lies in the infant classes, and the hygiene of infant classes therefore requires special study. It certainly involves special difficulties. It is open to question whether the encouragement of the attendance of children at school before the age at which such attendance becomes compulsory is justifiable. The attendance of these children is the cause of a considerable loss of life. Are teachers prepared to state that the educational advantages of securing the attendance at school of children under five years of age are so great that the sacrifice of life, if it be a necessary consequence of the school attendance, is not too heavy a price to pay? We admit that a certain amount of loss of life from infectious diseases is not too heavy a price to pay in return for the immense national advantages secured by compulsory school attendance in this country. It cannot be too clearly emphasised, however, that the best means of securing the efficiency of our national system of compulsory education is to reduce to the lowest possible minimum the number of cases of infection caused by it. Now, school attendance before the age of five years (*a*) greatly increases the number of such cases, and (*b*) increases these cases at an age when they are most fatal. We repeat, Are the educational advantages of school attendance before the age of five years commensurate with the loss of life which it causes? If not, then teachers and doctors together might hope to prevent the attendance of such extremely young children at school, and thus remove one of the greatest difficulties in checking the spread of infectious diseases in connection with school life. This subject cannot be pursued further at the present time. We propose, however, to devote the first articles in this series to a consideration of the means of preventing the spread of infectious diseases by school life. Subsequently we shall deal with the structural aspects of school life, as to school buildings, furniture, lighting, ventilation, warming, and drainage; finally dealing with the intellectual aspects of school life.

The importance of the subject cannot well be exaggerated. To secure the greatest economy of effort and the maximum result, measures for the promotion of the national health, and for the prevention of disease, should be in the directions in which there is the greatest scope for their operation. From this utilitarian standpoint, it is obvious that efforts to secure the highest standard of health among the young are of supreme importance, as upon the conditions under which they live during the first fifteen—and more particularly the first ten—years of their life depend very largely their future prospects of good or ill health, of long or short life. Looking at the problem still from the same standpoint, it is clear that while from one-third to one-half of each day is spent under the conditions of home life, about one-fifth of each school day is spent under the conditions of school life. The study of the conditions determining a healthy school life is therefore only second in importance to that of the conditions of healthy home life.

The structural aspect of school hygiene is regulated for elementary schools by the Code of Regulations for Day Schools issued by the Education Department. This Code will probably be adopted in a modified form by the Board of Education to come into existence in April next; but we sincerely hope that the new Board will not rest content with a modification only of the regulations in the present Code, but that these regulations will be greatly improved, and that the conception of hygiene may be amplified to include every branch of school hygiene, whether dealing with the physical, the intellectual, or the moral aspects of health.

The third section of the Board of Education Act, 1899, states that "the Board of Education may.....inspect any school supplying secondary education, and desiring to be so inspected, for the purpose of ascertaining the character of the teaching in the school, and the nature of the provisions made for the teaching and health of the scholars," etc.; and further provides that "the councils of counties or county boroughs may contribute towards the expense of inspecting under this section any school within their county or borough."

Although the terms of the above enactment are purely voluntary, and it is optional on the part of the proprietors and directors of secondary schools, of the Board of Education, and of the local governing bodies each and severally to refuse to take any share in carrying out the above scheme, there is little doubt that in the near future a large proportion of secondary schools, whether under private management or under the control of committees

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or limited companies, will be submitted to inspection in accordance with its terms. This being so, it is desirable that the scope of the inspection, so far as the health of scholars is concerned, should be freely canvassed, and that school proprietors and managers should know what may reasonably be expected from them. In ascertaining what is now considered by the Education Department to be indispensable to place school premises in an efficient hygienic condition, they cannot do better than consult Schedule VII. of the Code of Regulations for Elementary Day Schools, which specifies the structural requirements in the planning and fitting up of public elementary schools. As it is highly probable that these will form the model for similar requirements for secondary schools, they deserve careful and critical examination, although they form a part only of what is properly included in school hygiene. And here let me say that although the contents of this schedule require, and will receive in subsequent articles, considerable criticism, the Education Department has been instrumental, through its regulations and inspections, in securing a relatively high standard of structural excellency in our elementary schools, which appears, to those of us who remember those schools twenty years ago, deserving of the highest praise.

(To be continued.)

SOME PHYSICAL ASPECTS OF THE PUPIL.*

BY J. GUNN, M.A., D.SC.,
Author of "Class Teaching and Management," etc.

II.

THE next consideration I shall notice, as important in classifying our pupils as normal or otherwise, is an apparently simple one. Before we can teach a group of pupils as a class, we must be sure that their *organs of sense* are normal, particularly sight and hearing. *Normal*, I have said; but this is hardly the right word to use. Normal in this sense means *as they ought to be*, or *perfect*. But if we limited our class to those who are strictly normal in sight and hearing, we should be likely to have a very small class indeed. You will perhaps say that this is a very simple matter; a teacher will soon find out these things as class work proceeds. True, he will soon find out the cases of glaring deficiency, and will make some special arrangements for these. But, as a matter of fact, there are all degrees of deficiency—from, say, perfect or normal vision down to the stage where spectacles are necessary. And, indeed, spectacles are often necessary when neither teacher nor pupil is aware of the fact. Cases have occurred where a boy was quite unaware for years that his sight was defective, and when by chance spectacles were recommended and used, he found himself living in a changed world.

Now what does this mean to the pupil? He does his work, it may be he does it well, and no one suspects any visual defect. But the books and other apparatus he uses were provided for those with normal vision. In order to do his work, the poor boy is subjecting himself to a cruel nervous strain—a strain which *he* thinks is the usual and necessary accompaniment of school work, and which no one else is aware of. I need hardly point out the danger of such a strain to a growing boy: that is, again, a little aside from my line of thought. But you know that if undue attention is required for the visual parts of his learning, he has the less energy to bestow on the other parts.

With a little more deficiency in vision, but still too little to be noticed, the pupil cannot, even by any amount of strain, do his proper work. He misses points of detail, and gains the reputation of being careless. He may even incur the punishment of getting extra tasks to perform—not the best way of improving his eyesight. And so things go on, perhaps, until his eyes become so weak that some one sees that they *are* weak; then he may get the aid of spectacles, and live a little more happily. Had the weakness been suspected in time, by modifying his school work in certain ways it might have been, if not remedied, at least prevented from increasing.

In a large number of school children examined by a specialist on behalf of the English Education Department, defective sight was found more common in the older pupils than in the younger, and more common among girls than among boys. Home lessons and fine needlework may occur to some of you as possible explanations: I offer no theory of my own on the subject.

So much, then, for the sense of sight. It is the most important means in our school work for reaching the mind of the pupil. Shall we say, therefore, that it is always carefully tested by us, not once in school life, but at least once a year, and the result of our test noted? Surely it is as important for us to know as the number of mistakes in arithmetic and in dictation which a boy makes when he enters our class. Shall we assume that every school, perhaps every classroom, is provided with the simple apparatus necessary to test the sight, and that every teacher knows how to use it? And further, shall we say that, by means of applying this test, every pupil who is just a very little sub-normal in vision has a seat in the best-lighted part of the room, and near the blackboard? I know of schools where all this *is* done; I know of others where it is *not* done. But we are not at present in the confessional, and we need not say just how little attention we do give to the matter.

The sense of hearing, again, is second only to that of sight as an educational instrument, if, indeed, it be not rather equal to it. If you ask a blind man whether he would accept the gift of sight on condition of losing his hearing, he would in most cases decline. Of course, to the blind, hearing means a great deal more than we can imagine. But even to those who possess sight, the ideas gained through the ear form a large part of their mental acquisition.

Now here, again, when a uniform test is applied, our pupils show variations from the normal which are often unsuspected by teachers and pupils alike. I need not go through the train of thought here that was followed in regard to sight, and point out how much of the teacher's oral instruction, and still more of his classmates' oral answering, is lost, or followed with difficulty, by a boy with slightly dull hearing. If good work is done, it is at a severe cost. If the work suffers, and yet the cause of loss is not discovered, the teacher simply regards the boy as of slow intellect, and perhaps the boy himself accepts the explanation.

Certainly, when they are tested, we find the number of pupils with defective hearing enormously larger among dull pupils than among bright ones, and this apart from the number of those who are *known* to be slightly deaf. If you care to make the experiment, you will find that three things are very commonly combined in the noble army of duffers, and these things are—*backward mental development, slight dullness of hearing*, and the *habit of breathing through the mouth*. If you were to paint a portrait of the typical duffer, you would almost certainly paint him with his mouth open—not wide open or agape, but partly open and relaxed. More than this: if you ever at any time feel yourself particularly silly or stupid, you will almost certainly find your mouth open at the time. This remark, of course, only applies to those of you who *have* experienced such a feeling; the others must take it on authority.

This sign of the open mouth is in some cases only an indication of what we may call a slack or low nervous tone, just as listless movements in general are. But the habit of mouth-breathing may mean something quite different. It may be due to a thickened or congested state of the lining of the nasal passages, which makes it difficult to breathe through the nose, as if one had a chronic cold in the head. This often accompanies a closing up of the eustachian tubes leading from the back of the mouth to the middle ear, and thus imperfect hearing is a very common accompaniment of mouth-breathing. More than this: there are certain growths which

* Read at the Edinburgh Congress of E.I.S.

such as measles, scarlet fever, and diphtheria; and the deficient ventilation which characterises so many of our schools renders the spread of these diseases more rapid and complete than it would otherwise be. Middle-aged people do not escape from attacks of these diseases to the large extent which we know to be the case simply because they have suffered from them in early life, and have thus purchased their immunity. Even those who have not previously had an immunising attack suffer with comparative rarity from any of the three diseases named above after youth has passed. Every additional year of life appears to confer a small proportion of additional immunity, rendering it less likely that the person exposed to infection will prove to be a suitable soil for its development. This is a sufficient answer to those wise (?) mothers who think it a good thing, when one child is attacked with measles, to put the other children with the patient, in order "that they may get it over." Such a policy endangers the life of the children thus experimented upon, endangers their future prospects of health if they recover from the acute attack, and creates fresh foci of disease endangering the health of the community. On the contrary, if a child can be prevented from taking an infectious disease until he has reached the age of seven years, or, still better, if he can be prevented until his eleventh year, two things happen: (*a*) he is now much less likely to catch the infection, even though exposed to it; and (*b*) even though he does develop the disease, his prospects of recovery are much greater than they were at the earlier age. The first point is clearly proved by statistics which it is not necessary to quote. The second point is so important that I venture to quote actual figures based on experience of an epidemic of measles, and to express the wish that the true significance of these figures could be brought home to every mother in the country. If this could be done, we should hear less of the careless exposure of young children to infectious diseases which is now common. Experience has shown that out of every 1,000 attacked with measles at all ages, 61 die. The fatality varies greatly at different ages. Thus, in infancy (under one year of age) 96 succumb out of every 1,000 attacked; in the second year of life, 197 out of every 1,000 attacked; in the third, 102; in the fourth, 49; in the fifth, 15; and at ages five to ten, 11 out of every 1,000 attacked.

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SOME PHYSICAL ASPECTS OF THE PUPIL.*

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Author of "Class Teaching and Management," etc.

II.

THE next consideration I shall notice, as important in classifying our pupils as normal or otherwise, is an apparently simple one. Before we can teach a group of pupils as a class, we must be sure that their *organs of sense* are normal, particularly sight and hearing. *Normal*, I have said; but this is hardly the right word to use. Normal in this sense means *as they ought to be*, or *perfect*. But if we limited our class to those who are strictly normal in sight and hearing, we should be likely to have a very small class indeed. You will perhaps say that this is a very simple matter; a teacher will soon find out these things as class work proceeds. True, he will soon find out the cases of glaring deficiency, and will make some special arrangements for these. But, as a matter of fact, there are all degrees of deficiency—from, say, perfect or normal vision down to the stage where spectacles are necessary. And, indeed, spectacles are often necessary when neither teacher nor pupil is aware of the fact. Cases have occurred where a boy was quite unaware for years that his sight was defective, and when by chance spectacles were recommended and used, he found himself living in a changed world.

Now what does this mean to the pupil? He does his work, it may be he does it well, and no one suspects any visual defect. But the books and other apparatus he uses were provided for those with normal vision. In order to do his work, the poor boy is subjecting himself to a cruel nervous strain—a strain which *he* thinks is the usual and necessary accompaniment of school work, and which no one else is aware of. I need hardly point out the danger of such a strain to a growing boy: that is, again, a little aside from my line of thought. But you know that if undue attention is required for the visual parts of his learning, he has the less energy to bestow on the other parts.

With a little more deficiency in vision, but still too little to be noticed, the pupil cannot, even by any amount of strain, do his proper work. He misses points of detail, and gains the reputation of being careless. He may even incur the punishment of getting extra tasks to perform—not the best way of improving his eyesight. And so things go on, perhaps, until his eyes become so weak that some one sees that they *are* weak; then he may get the aid of spectacles, and live a little more happily. Had the weakness been suspected in time, by modifying his school work in certain ways it might have been, if not remedied, at least prevented from increasing.

In a large number of school children examined by a specialist on behalf of the English Education Department, defective sight was found more common in the older pupils than in the younger, and more common among girls than among boys. Home lessons and fine needlework may occur to some of you as possible explanations: I offer no theory of my own on the subject.

So much, then, for the sense of sight. It is the most important means in our school work for reaching the mind of the pupil. Shall we say, therefore, that it is always carefully tested by us, not once in school life, but at least once a year, and the result of our test noted? Surely it is as important for us to know as the number of mistakes in arithmetic and in dictation which a boy makes when he enters our class. Shall we assume that every school, perhaps every classroom, is provided with the simple apparatus necessary to test the sight, and that every teacher knows how to use it? And further, shall we say that, by means of applying this test, every pupil who is just a very little sub-normal in vision has a seat in the best-lighted part of the room, and near the blackboard? I know of schools where all this *is* done; I know of others where it is *not* done. But we are not at present in the confessional, and we need not say just how little attention we do give to the matter.

The sense of hearing, again, is second only to that of sight as an educational instrument, if, indeed, it be not rather equal to it. If you ask a blind man whether he would accept the gift of sight on condition of losing his hearing, he would in most cases decline. Of course, to the blind, hearing means a great deal more than we can imagine. But even to those who possess sight, the ideas gained through the ear form a large part of their mental acquisition.

Now here, again, when a uniform test is applied, our pupils show variations from the normal which are often unsuspected by teachers and pupils alike. I need not go through the train of thought here that was followed in regard to sight, and point out how much of the teacher's oral instruction, and still more of his classmates' oral answering, is lost, or followed with difficulty, by a boy with slightly dull hearing. If good work is done, it is at a severe cost. If the work suffers, and yet the cause of loss is not discovered, the teacher simply regards the boy as of slow intellect, and perhaps the boy himself accepts the explanation.

Certainly, when they are tested, we find the number of pupils with defective hearing enormously larger among dull pupils than among bright ones, and this apart from the number of those who are *known* to be slightly deaf. If you care to make the experiment, you will find that three things are very commonly combined in the noble army of duffers, and these things are—*backward mental development*, *slight dullness of hearing*, and the *habit of breathing through the mouth*. If you were to paint a portrait of the typical duffer, you would almost certainly paint him with his mouth open—not wide open or agape, but partly open and relaxed. More than this: if you ever at any time feel yourself particularly silly or stupid, you will almost certainly find your mouth open at the time. This remark, of course, only applies to those of you who *have* experienced such a feeling; the others must take it on authority.

This sign of the open mouth is in some cases only an indication of what we may call a slack or low nervous tone, just as listless movements in general are. But the habit of mouth-breathing may mean something quite different. It may be due to a thickened or congested state of the lining of the nasal passages, which makes it difficult to breathe through the nose, as if one had a chronic cold in the head. This often accompanies a closing up of the eustachian tubes leading from the back of the mouth to the middle ear, and thus imperfect hearing is a very common accompaniment of mouth-breathing. More than this: there are certain growths which

* Read at the Edinburgh Congress of E.I.S.

not uncommonly form and obstruct the nasal passages, and thus produce the habit of mouth-breathing, and at the same time cause dullness of hearing. These growths, by their pressure on certain blood-vessels, also diminish the supply of blood to parts of the brain, thus causing a certain loss of brain power. Such growths are now frequently removed by a surgical operation, with the happiest results. I heard recently of the case of a boy who was regarded as almost an imbecile, and had been unable to learn more than the first three letters of the alphabet during, I think, a year or more at school. On his being examined, it was found necessary to remove certain adenoid growths which had obstructed the nasal channel. The result was an entire change in the boy's *intellectual* power. He now learned his alphabet easily and rapidly, and became as bright and alert in work and in play as any of his comrades. The change, of course, was chiefly due to an improved and unobstructed supply of blood to the brain, and in part, no doubt, to the restoration of perfect hearing. It is now becoming recognised that children who are mouth-breathers and dull of hearing and intellect require skilled medical examination, with a view to having any such obstruction removed if it exists.

There can be no doubt that many of the headaches which are known to exist among school children are due to the strain required for ordinary work from those who are slightly defective in sight or in hearing. It is among such children that over-pressure is a reality rather than among normal individuals.

It is easy to test the state of the special organs of sense, the eye or the ear. But the general state of the brain and nervous system is no less important, and that seems less easy for us to examine. We all know children that are notoriously dull and slow, or that are persistent fidgets: do we usually regard these characteristics as physically due to the state of the nervous system, or merely as special forms of original sin? In many cases, I fear, we look on them as moral failings, and incline to treat them accordingly, after the time-honoured prescription of Solomon. And yet the opinion is growing that an attack of fidgets is as purely a nervous and physical phenomenon as an attack of toothache.

One of the primary functions of the brain is to cause and regulate muscular movements. The very best way, therefore, to judge of the condition of the brain is simply to watch the movements of the muscles, especially the semi-involuntary movements of the smaller and more mobile groups, such as those of the face and of the hands; and we may add to this, the habitual pose and symmetry of the body when at rest, as showing the tension of the muscles which support the various parts of the body in its normal upright position.

Expert physiologists who have studied children in this aspect have been able to give us a fairly long list of what they call *nerve signs*, by which we can know at once the general state of the brain as to the energy available for work in school. Some of those signs are given by the face, which shows easily the movements and tone of its muscles. The habit of frowning or of wrinkling the forehead, too great or too little mobility of the mouth, and the movements of the eye, are some of the more obvious "nerve signs."

The pose of the hand, when the arms are extended together in front of the body, hands palm downwards, also gives a clue to the nerve energy. Strength and weakness are easily seen by those who know how to read the "nerve signs" of the extended hand. If some of us were to ask our pupils to hold out their hands in this way, and learn our lesson from their position, it might save us and them some disagreeable consequences that result in our asking them to hold out their hands in the other way—the time-honoured attitude—palm upwards. We might learn from our observation that certain pupils have not the nerve power or nerve control to do the work or to maintain the behaviour which we assume to be within the power of all.

Now this is a dangerous line of thought—dangerous for our peace of mind and conscience. Are there really children who appear quite normal, and yet who, from a lack of nerve power, are physically unable to give the attention we require, or to rule their conduct as we demand? How many such have we regarded as simply lazy or wilfully careless in behaviour, treating them accordingly? Perhaps our punishments were not severe, and so our conscience is not much disturbed. Yes; but there is worse behind: we failed to make the best of them in education, for we did not know their limits. And besides, we made their school life unhappy for them, even as they made our school work unhappy for us. Worse than all, we may have forced the belief upon them that they were really lazy and worthless creatures, and thus we may have lowered their self-respect, and done them a grievous injury. Let us hope these pupils knew they were doing their best. In that case they will have a poor opinion of *us*. Far better that than if they really believed us and formed a poor opinion of *themselves*. The mere thought of doing such things even in ignorance is very uncomfortable. Let us forget it if we can. If we can't, let us echo Kipling's prayer in his last book, "God help all schoolmasters!"

But you may ask, What good will it do us to know and observe such nerve signs? Well, there are found to be between one and two per cent. of children, not imbeciles, who are quite unfit to profit by ordinary school work, and these we must discover. For these, special schools or classes are needed. There are several such schools in London, and a special Act of Parliament has been obtained to secure proper school advantages for such children, just as for the blind or deaf. Glasgow, too, has a special class for such children, under a specially skilled teacher, and the results, as noted in last Bluebook and elsewhere, show the benefit of the arrangement. We can also find out in time the children who may require special treatment in our ordinary classes—a still larger percentage than the former. And we shall be in a position to co-operate with parents and medical advisers in making the best of such exceptional cases both at home and in school.

The last physical condition bearing on school work which I shall notice is *fatigue*. All teachers know, in a general way, how fatigue renders attention impossible. It is necessary, therefore, that we should know the symptoms of fatigue when they begin to appear. Further, we should know what exercises in school cause fatigue soonest, or require most nerve energy for their performance, and we should arrange our time-tables accordingly.

Much care has been given to this subject recently, and many ingenious experiments have been made in connection with fatigue. Intelligent teachers and able physiologists have been working together on its problems; but while they have much that is new to tell us, their work is by no means finished.

If by chance any of you have not been keeping abreast of the literature of your profession, you may be surprised to learn what is the exercise which causes most fatigue in school. It is not mental arithmetic or grammar, but physical exercises or gymnastics. This may seem a strange fact, until you remember that what we call muscular fatigue is really nerve fatigue. It is not the muscle, but its exciting nerve, that refuses to work until it is repaired by rest. Now, all expression of thought, by voice or pen, implies muscular motions, and therefore waste of nerve tissue. And even thought itself implies a precisely similar waste of nerve. The more active the motion, the greater the waste and consequent fatigue. Hence we must revise our old belief that muscular exercise is the best form of rest after, or preparation for, close thinking. And we can easily see also that "grinding" and athletics combined, as some students wrongly combine them, are a clear example of burning the candle at both ends. Some of our hardest-working journalists declare that a day in bed does them more good than a day in the country. Physiology justifies their belief. Common-sense may lead some of you to follow their example.

In these remarks, I have tried to discuss a few of the physical aspects of the pupil which have a direct bearing on his work in school. There are others which, as well as these, have more or less important bearings on his health and growth, but these I leave aside. They concern directly the parent, or the master of a boarding-school, rather than the teacher in the day-school. I think that I have said enough to show the usefulness of remembering that the child is an animal. And, moreover, the child is a *young* animal—one which should be growing. Whenever work causes waste

which the body cannot more than make good, growing is impeded. To keep our school exercises well within that limit is an obvious duty, and one which requires considerable knowledge of physiology, and care in studying the pupils individually.

Were I to conclude with a motion, it would run somewhat in these terms:—That the training of the teacher should embrace a thorough grounding in the facts of human physiology, and due exercise in what is now known as experimental physiology; and that School Boards should employ skilled medical men to superintend, guide, and advise teachers in all such questions as those I have here discussed. Many intelligent school managers in England and elsewhere already do this; and with the growth of knowledge, through the research which is now actively carried on in the more enlightened countries of the world, we may hope soon to see such a reform extended to every school in our country.

"LITTERÆ HUMANIORES" IN ELEMENTARY SCHOOLS.

LEST the above should meet the eye of some susceptible ratepayer of the London or another School Board area, let us say at once that by this grandiose title we mean nothing at all high-flying, but merely something very simple indeed. Whatever the universities may understand by *the humanities*, a very different thing is understood by them in our elementary schools. The distressed ratepayer therefore may proceed placidly along his way, well assured that the humanities, in the classic sense, will not cross the threshold of the people's schools in England either in his time or his children's, even though the greatest thinker of Germany has told us they have of all studies the most softening influence in the world. His country, of course, took the hint thus given it a hundred years ago, and included them in its elementary curriculum; and our well-educated neighbour, Scotland, also long since gave its poorest sons an opportunity of receiving "the most softening influences"—two facts, perhaps, superfluous to mention when the position of these two countries among the world's successful nations is so well known. But we in England, having, comparatively speaking, very recently begun to build up an educational system for the people, must wait patiently: the dome cannot take its place till the main edifice is reared. But what we can do is to see that the building materials, however unpretentious, are the best of their kind; and *the humanities*, in their most literal elementary-school sense, are of the best, and should be the cement binding all else together, for apart from them education may become a dangerous instead of a beneficial thing. This has long been recognised by the Education Department; and some years ago, when they received the report of the Royal Commissioners of 1888, "My Lords" clearly expressed the recognition by making the discipline and organisation grant awarded to schools depend, among other things, on the children's "consideration and respect for others." And in 1894 they went still further, and gave official encouragement to what of necessity follows "consideration for others"—namely, consideration for dumb animals; and then these words were introduced into "The Instructions to Inspectors:" "Passages [in readers] impressing on the children the duty of gentleness and consideration for others, *and that of humane treatment of animals, may be wisely introduced.*" However much it may be regretted that these steps were not taken in 1839, when the Committee of Council on Education had its birth, instead of more than a half-century later, when only a very few years of individual life were remaining to it, we cannot but be thankful that the large body, though it moved so very slowly, did before its extinction move at all. And what has been the corollary of this movement? Just this. Another large body, though not so large, has also moved—had a shock, that is, from the same battery, we believe, which woke up the greater; and being smaller, only six years have been required for it to make up its mind to pass a resolution which may, if the teachers so will it, beneficially affect every Board School child in London. One regrets to add that, as the matter stands at present, the resolution is so hampered with conditions as almost to nullify the good that is in it; but, all the same, we are grateful for it even as it stands—grateful with that peculiar kind of gratitude which has in it a stronger sense of favours likely to come than of those already received. But whatever may be done or left undone by big bodies or by little, and however bright the battery of the R.S.P.C.A. may be kept, we as teachers can take up or continue our humane work with the pleasant consciousness that the individual is often more than the mass, especially the individual who has the pleasure of working with such plastic material as we have in hand, and that it lies more potently with us than with any other class of the community to help to heal up that open sore of the world, the sufferings of dumb creatures. And the work is so easy, for no one will say you nay in it—much more easy, perhaps, than is temperance work among the young: for many persons who would not for the world say a discouraging word to our friends who work in this direction, have a feeling of doubt about its results, recognising that drink is not a child's temptation; whilst no healthy-minded person who remembers his childhood will deny that abuse of power is specially a child's temptation. The reason of this, perhaps, lies near the surface; and though as teachers we may be more concerned in finding a remedy for the disease than in tracing its origin, it may be said that possibly the tyranny of children is merely a bad copy of the legitimate power of adults over them. Except with those younger than themselves, children can only exercise dominion over the lower animals. Incidentally this suggests how humanely and carefully children themselves should be treated. It is common knowledge that since our methods with the young have become more gentle, their behaviour to dumb animals has improved proportionately. And all along the line this humanitarian feeling is exhibited, there being no room to doubt that the "powers that be" are full of it; so that all who make up their minds that humanity shall have the first word in their schools have only to consider what tools shall be used. The old, possibly, need refurbishing, and the new must be welcomed; for children are always new, and human nature is always old. He who adapts himself to this combination of ancient and modern will be the most successful. An excellent lever will be found ready to hand in humane literature—the veritable *litteræ humaniores* of the masses.

"But there is so much of it, how shall we distinguish what is best to use in our very limited time?" says some one. Certainly, since 1894 the educational publishers have provided well for us, and their lists are easily obtained; and for every other purpose the little pamphlet referred to in our paper of last month, which is freely provided by the R.S.P.C.A., will be found most useful. But there is one book that calls for more than passing notice, either as a reader or a library or a prize book: we mean Miss Sewell's *Black Beauty; or, The Autobiography of a Horse*. Very recently we saw from an advertisement that Mr. Michael Sadler was about to give a lecture on "St. Francis of Assisi, a Brother of the Birds," and it occurred to the mind immediately that Miss Sewell equally—nay, even more eminently—deserves to be known as a "Sister of the Steed." Her book seems to crown all that has been written for children by humanitarians, and deserves to be, as regards the horse, the young people's manual. *The Penny Poets*, too, are very helpful, and we are hoping soon to see a pennyworth devoted entirely to humane poetry. For periodical reading, *The Band of Mercy*, at a halfpenny a month, is a prime favourite with the mass of elementary school children; they enjoy its excellent illustrations as much as the text, which is little wonder, considering the publication costs more than they pay for it. *The Animal World*, for older boys and girls, is also very pleasing. But the mass of literature the young folks can put together themselves by scissors and paste, from the newspapers, is surprising. They just want guiding, so as not to collect instances of cruelty. In the same way, before they expend their pence, they need to be told what the market offers.

In those schools which have a reading circle in connection with the National Home Reading Union, there are the

Union's lists to help. Generally there is something on the subject in them, and these books, being intended for home reading, influence a larger circle than most of our school books.

But for our special in-the-school *litteræ humaniores*, let us, despite our hasty remark as to the non-existence of classic lore there, refer to the people's classic, which is everywhere. The Bible is a very mine of humane teaching, and everybody acquainted with children knows how much they like its teachings and its narratives—the archaic form in which these are conveyed seeming to specially attract them. From it you can treat of our subject as a whole, or divide and subdivide almost *ad infinitum*. If *authority* be wished for, it lies in the decalogue, where the commandment which enjoins Sabbath rest on man includes "cattle" in the benefit. And in Deuteronomy we have, "Thou shalt not muzzle the ox when he treadeth out the corn," and also, "Thou shalt not plow with an ox and an ass together;" and in Proverbs, Lemuel receives this concise injunction, "Open thy mouth for the dumb."

If it be *example* of the highest kind that is looked for, it is exhibited everywhere—from the care of the Creator, who "causeth the grass to grow for the cattle," and is mindful of the fallen sparrow, to that of our Lord, who will not allow the disciples to bring for His service the mother ass without her colt.

And of other examples, how children love to hear of David, whose courage was displayed so finely for the sheep of his flock! They recognise, too, the *detail* of the youthful shepherd's humane care in the attributes he ascribes to God in the character of a shepherd in that psalm so generally taught in schools. But the material is so plentiful, and the mode in which it can be treated occurs so readily to every one, that we will only make one further allusion to it, and that because there are some persons in the world who assert that animals have no rights. The great majority of children everywhere learn some portion of Christ's sermon on the mount, including those words, "Blessed are the merciful;" and many also learn these words of Solomon, who was not only king and poet, but also an enthusiastic naturalist: "A righteous man regardeth the life of his beast." Children are not slow in making the inference from these two texts that it is not only *right* to be humane to dumb creatures, but that happiness or "blessing" follows this right-doing. So far the teaching of the Book that may be utilised in the daily Bible lesson.

Naturally there comes to the mind next, as an ally for the secular hours of school, our greatest poet. Shakspere speaks critically of every quality of man, but we think we are right in saying that the virtue of mercy receives his highest homage, and is described in language so striking as to force attention to it from all alike. Has he attributed to any other quality such twofold beneficence? And is there any reason why his utterances on mercy should not be learned by every English child, as a common heritage and a future safeguard against cruel tendencies? There is nothing in the two extracts following beyond the understanding of children:—

> "No ceremony that to great ones 'longs,
> Not the king's crown, nor the deputed sword,
> The marshal's truncheon, nor the judge's robe,
> Become them with one half so good a grace
> As mercy does."
>
> *Measure for Measure*, Act ii., Scene 2.

> "The quality of mercy is not strained;
> It droppeth, as the gentle rain from heaven
> Upon the place beneath: it is twice blest;
> It blesseth him that gives and him that takes.
> 'Tis mightiest in the mightiest: it becomes
> The throned monarch better than his crown."
>
> *Merchant of Venice*, Act iv., Scene 1.

And many other selections will occur to the minds of our readers; but we will leave the highest authorities here, and see what the next in order, the very high, have to say on the same theme.

Let us omit the great prose writers, all of whom agree with the great poets in extolling the practice of humanity both to man and beast, and keep to the poets, as best suited to children's imaginations and memories.

And shall not Cowper have the first place? for no more humane genius has ever graced our country's literature. It is quite to a child's taste to hear the story of his hares, Tiney and Puss; of his cat in the chest of drawers; and of Mrs. Throckmorton's bullfinch; and then to learn the following little bits leading up to that beautiful portion of "The Winter Walk at Noon," beginning with, "I would not enter on my list of friends." Shall we be excused for quoting extracts from them here?

"EPITAPH ON A HARE.

> "Old *Tiney*, surliest of his kind,
> Who, nursed with tender care,
> And to domestic bounds confined,
> Was still a wild Jack hare.....
>
> "I kept him for his humour's sake;
> For he would oft beguile
> My heart of thoughts that made it ache,
> And force me to a smile.
>
> "But now beneath his walnut shade
> He finds his long last home,
> And waits, in snug concealment laid,
> Till gentler *Puss* shall come.
>
> "He, still more aged, feels the shocks
> From which no care can save,
> And, partner once of Tiney's box,
> Must soon partake his grave."

"THE RETIRED CAT.

> "A poet's cat, sedate and grave
> As poet well could wish to have,
> Was much addicted to inquire
> For nooks to which she might retire.....
> A drawer, it chanced, at bottom lined
> With linen of the softest kind.....
> A drawer impending o'er the rest,
> Half-open in the topmost chest,
> Of depth enough, and none to spare,
> Invited her to slumber there.....
> That night, by chance, the poet watching,
> Heard an inexplicable scratching:
> His noble heart went pit-a-pat,
> And to himself he said, 'What's that?'.....
> He left his bed, he trod the floor,
> He 'gan in haste the drawers explore.
> Forth skipped the cat," etc., etc.

The classical poetry quoted below is not at all beyond the capacity of upper-class children, as many have found who have tried it:—

> "I would not enter on my list of friends
> (Though graced with polished manners and fine sense,
> Yet wanting sensibility) the man
> Who needlessly sets foot upon a worm.....
> They are all—the meanest things that are—
> As free to live, and to enjoy that life,
> As God was free to form them at the first,
> Who in His sovereign wisdom made them all.
> Ye, therefore, who love mercy, teach your sons
> To love it too."

Leaving Cowper to mention Wordsworth is to call up to most minds "The Pet Lamb," which for generations has delighted young children.

And who, when searching for the suitable, can forget Shelley's "Skylark"? *Could* any child grow up to be a lark-eater after learning those beautiful lines? And will not the sight of strings of these birds in gas-lighted London shops draw a sigh from the child who during the day has been following in the poem the flight "to heaven's gate or near it" of the full-hearted songsters? "Show me the *stupidest* man, and I will show you the cruellest," says some one whose name at present we cannot recall. When the minds of the young are expanded by beautiful literature, which is always humane, the cruelty which arises from stupidity will be a thing of the past.

And now let us conclude with recommending, to this end, the breathings of the warmest heart that ever beat, leaving

out of consideration the minor poets, whose help with the younger children is also invaluable.

Burns, *the* poet of Scotland, is also the poet *par excellence* of humanity, and speaks, as genius generally does, as strikingly to the fresh hearts of the young as to those maturer. Do not let us say his dialect is a difficulty, for happily his distinctly humanitarian pieces, with one exception, are the most easy to English eyes and ears; and that exception is "The Auld Farmer's New-Year Morning Salutation to his Auld Mare Maggie," which Carlyle says is worthy to rank with some of the Greek anthology, so the teacher can keep that as a *bonne bouche* for himself. The children easily learn, and we know from experience that they delight in repeating (even though a Scotchman might fail to understand them):—

"Wee, sleekit, cow'rin', tim'rous beastie,
Oh, what a panic's in thy breastie!
Thou needna start awa' sae hasty,
Wi' bickering brattle!
I wad be laith to rin an' chase thee
Wi' murd'ring pattle!

"I'm truly sorry man's dominion
Has broken Nature's social union,
An' justifies that ill opinion
Which maks thee startle
At me, thy poor earth-born companion,
An' fellow-mortal!"

They read with great interest, too, verses "On seeing a Wounded Hare limp by me which a Fellow had just Shot," especially the second one:—

"Go live, poor wanderer of the wood and field,
The bitter little that of life remains;
No more the thickening brakes and verdant plains
To thee shall home or food or pastime yield."

And those other verses "On Scaring some Water Fowl on Loch-Turit:"—

"Why, ye tenants of the lake,
For me your wat'ry haunt forsake?
Tell me, fellow-creatures, why
At my presence thus you fly?.....
Conscious, blushing for our race,
Soon, too soon, your fears I trace.....
Man, to whom alone is given
A ray direct from pitying Heaven,
Glories in his heart humane—
And creatures for his pleasure slain."

It is said that tenderness towards the lower animals is part of the true poetic instinct. Burns's part was so large that it flowed over from them even to the flowers. Hear him when, by accident, he turns one down with his plough:—

"Wee, modest, crimson-tippèd flower,
Thou's met me in an evil hour;
For I maun crush amang the stour
Thy slender stem.
To spare thee now is past my power,
Thou bonnie gem."

It was the Ettrick Shepherd who said, "Burns must have been an exceedingly kind-hearted being; for whenever he has occasion to address or mention any subordinate being, however mean, even a mouse or a flower, then there is a gentle pathos in his language that awakens the finest feelings of the heart." This reminds one of how much of kind-heartedness there is to tell of Hogg himself. No child ever listens without delight to the story of his companionship with his dog Sirrah, who could bring back from the mountain in the darkest night the whole of a lost flock, merely on hearing his master say in despair, "Alas, Sirrah, the sheep are a' awa'!"

Indeed, the stores are infinite from which people of all classes can draw materials best suited to their own manner of workmanship, and the present is no ill-fitting season in which to work more earnestly than ever in humanity's great cause.

Whether, with the Pope and the German Emperor, we regard the new year as the first of a new century, or believe it to be the last of the old, it is an excellent time to inaugurate a better kind of life for our dumb fellow-creatures, or to send off the dying century with a promise of that better life.

When the teachers of Great and of Greater Britain decide that the new creed of which we spoke in our last paper (that every sentient being has a right to as much happiness as possible, *because* it is a sentient being) shall be the universal creed of the children, we may welcome the new century, in full belief that before its close the echoes only will be heard of

"Those groans of nature in this nether world
Which Heaven has heard for ages."

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Union's lists to help. Generally there is something on the subject in them, and these books, being intended for home reading, influence a larger circle than most of our school books.

But for our special in-the-school *litteræ humaniores*, let us, despite our hasty remark as to the non-existence of classic lore there, refer to the people's classic, which is everywhere. The Bible is a very mine of humane teaching, and everybody acquainted with children knows how much they like its teachings and its narratives—the archaic form in which these are conveyed seeming to specially attract them. From it you can treat of our subject as a whole, or divide and subdivide almost *ad infinitum*. If *authority* be wished for, it lies in the decalogue, where the commandment which enjoins Sabbath rest on man includes "cattle" in the benefit. And in Deuteronomy we have, "Thou shalt not muzzle the ox when he treadeth out the corn," and also, "Thou shalt not plow with an ox and an ass together;" and in Proverbs, Lemuel receives this concise injunction, "Open thy mouth for the dumb."

If it be *example* of the highest kind that is looked for, it is exhibited everywhere—from the care of the Creator, who "causeth the grass to grow for the cattle," and is mindful of the fallen sparrow, to that of our Lord, who will not allow the disciples to bring for His service the mother ass without her colt.

And of other examples, how children love to hear of David, whose courage was displayed so finely for the sheep of his flock! They recognise, too, the *detail* of the youthful shepherd's humane care in the attributes he ascribes to God in the character of a shepherd in that psalm so generally taught in schools. But the material is so plentiful, and the mode in which it can be treated occurs so readily to every one, that we will only make one further allusion to it, and that because there are some persons in the world who assert that animals have no rights. The great majority of children everywhere learn some portion of Christ's sermon on the mount, including those words, "Blessed are the merciful;" and many also learn these words of Solomon, who was not only king and poet, but also an enthusiastic naturalist: "A righteous man regardeth the life of his beast." Children are not slow in making the inference from these two texts that it is not only *right* to be humane to dumb creatures, but that happiness or "blessing" follows this right-doing. So far the teaching of the Book that may be utilised in the daily Bible lesson.

Naturally there comes to the mind next, as an ally for the secular hours of school, our greatest poet. Shakspere speaks critically of every quality of man, but we think we are right in saying that the virtue of mercy receives his highest homage, and is described in language so striking as to force attention to it from all alike. Has he attributed to any other quality such twofold beneficence? And is there any reason why his utterances on mercy should not be learned by every English child, as a common heritage and a future safeguard against cruel tendencies? There is nothing in the two extracts following beyond the understanding of children:—

> "No ceremony that to great ones 'longs,
> Not the king's crown, nor the deputed sword,
> The marshal's truncheon, nor the judge's robe,
> Become them with one half so good a grace
> As mercy does."
>
> *Measure for Measure*, Act ii., Scene 2.

> "The quality of mercy is not strained;
> It droppeth, as the gentle rain from heaven
> Upon the place beneath: it is twice blest;
> It blesseth him that gives and him that takes.
> 'Tis mightiest in the mightiest: it becomes
> The throned monarch better than his crown."
>
> *Merchant of Venice*, Act iv., Scene 1.

And many other selections will occur to the minds of our readers; but we will leave the highest authorities here, and see what the next in order, the very high, have to say on the same theme.

Let us omit the great prose writers, all of whom agree with the great poets in extolling the practice of humanity both to man and beast, and keep to the poets, as best suited to children's imaginations and memories.

And shall not Cowper have the first place? for no more humane genius has ever graced our country's literature. It is quite to a child's taste to hear the story of his hares, Tiney and Puss; of his cat in the chest of drawers; and of Mrs. Throckmorton's bullfinch; and then to learn the following little bits leading up to that beautiful portion of "The Winter Walk at Noon," beginning with, "I would not enter on my list of friends." Shall we be excused for quoting extracts from them here?

"EPITAPH ON A HARE.

> "Old *Tiney*, surliest of his kind,
> Who, nursed with tender care,
> And to domestic bounds confined,
> Was still a wild Jack hare.....
>
> "I kept him for his humour's sake;
> For he would oft beguile
> My heart of thoughts that made it ache,
> And force me to a smile.
>
> "But now beneath his walnut shade
> He finds his long last home,
> And waits, in snug concealment laid,
> Till gentler *Puss* shall come.
>
> "He, still more aged, feels the shocks
> From which no care can save,
> And, partner once of Tiney's box,
> Must soon partake his grave."

"THE RETIRED CAT.

> "A poet's cat, sedate and grave
> As poet well could wish to have,
> Was much addicted to inquire
> For nooks to which she might retire.....
> A drawer, it chanced, at bottom lined
> With linen of the softest kind.....
> A drawer impending o'er the rest,
> Half-open in the topmost chest,
> Of depth enough, and none to spare,
> Invited her to slumber there.....
> That night, by chance, the poet watching,
> Heard an inexplicable scratching:
> His noble heart went pit-a-pat,
> And to himself he said, 'What's that?'.....
> He left his bed, he trod the floor,
> He 'gan in haste the drawers explore.
> Forth skipped the cat," etc., etc.

The classical poetry quoted below is not at all beyond the capacity of upper-class children, as many have found who have tried it:—

> "I would not enter on my list of friends
> (Though graced with polished manners and fine sense,
> Yet wanting sensibility) the man
> Who needlessly sets foot upon a worm.....
> They are all—the meanest things that are—
> As free to live, and to enjoy that life,
> As God was free to form them at the first,
> Who in His sovereign wisdom made them all.
> Ye, therefore, who love mercy, teach your sons
> To love it too."

Leaving Cowper to mention Wordsworth is to call up to most minds "The Pet Lamb," which for generations has delighted young children.

And who, when searching for the suitable, can forget Shelley's "Skylark"? *Could* any child grow up to be a lark-eater after learning those beautiful lines? And will not the sight of strings of these birds in gas-lighted London shops draw a sigh from the child who during the day has been following in the poem the flight "to heaven's gate or near it" of the full-hearted songsters? "Show me the *stupidest* man, and I will show you the cruellest," says some one whose name at present we cannot recall. When the minds of the young are expanded by beautiful literature, which is always humane, the cruelty which arises from stupidity will be a thing of the past.

And now let us conclude with recommending, to this end, the breathings of the warmest heart that ever beat, leaving

out of consideration the minor poets, whose help with the younger children is also invaluable.

Burns, *the* poet of Scotland, is also the poet *par excellence* of humanity, and speaks, as genius generally does, as strikingly to the fresh hearts of the young as to those maturer. Do not let us say his dialect is a difficulty, for happily his distinctly humanitarian pieces, with one exception, are the most easy to English eyes and ears; and that exception is "The Auld Farmer's New-Year Morning Salutation to his Auld Mare Maggie," which Carlyle says is worthy to rank with some of the Greek anthology, so the teacher can keep that as a *bonne bouche* for himself. The children easily learn, and we know from experience that they delight in repeating (even though a Scotchman might fail to understand them):—

"Wee, sleekit, cow'rin', tim'rous beastie,
Oh, what a panic's in thy breastie!
Thou needna start awa' sae hasty,
Wi' bickering brattle!
I wad be laith to rin an' chase thee
Wi' murd'ring pattle!

"I'm truly sorry man's dominion
Has broken Nature's social union,
An' justifies that ill opinion
Which maks thee startle
At me, thy poor earth-born companion,
An' fellow-mortal!"

They read with great interest, too, verses "On seeing a Wounded Hare limp by me which a Fellow had just Shot," especially the second one:—

"Go live, poor wanderer of the wood and field,
The bitter little that of life remains;
No more the thickening brakes and verdant plains
To thee shall home or food or pastime yield."

And those other verses "On Scaring some Water Fowl on Loch-Turit:"—

"Why, ye tenants of the lake,
For me your wat'ry haunt forsake?
Tell me, fellow-creatures, why
At my presence thus you fly?.....
Conscious, blushing for our race,
Soon, too soon, your fears I trace.....
Man, to whom alone is given
A ray direct from pitying Heaven,
Glories in his heart humane—
And creatures for his pleasure slain."

It is said that tenderness towards the lower animals is part of the true poetic instinct. Burns's part was so large that it flowed over from them even to the flowers. Hear him when, by accident, he turns one down with his plough:—

"Wee, modest, crimson-tipped flower,
Thou's met me in an evil hour;
For I maun crush amang the stour
Thy slender stem.
To spare thee now is past my power,
Thou bonnie gem."

It was the Ettrick Shepherd who said, "Burns must have been an exceedingly kind-hearted being; for whenever he has occasion to address or mention any subordinate being, however mean, even a mouse or a flower, then there is a gentle pathos in his language that awakens the finest feelings of the heart." This reminds one of how much of kind-heartedness there is to tell of Hogg himself. No child ever listens without delight to the story of his companionship with his dog Sirrah, who could bring back from the mountain in the darkest night the whole of a lost flock, merely on hearing his master say in despair, "Alas, Sirrah, the sheep are a' awa'!"

Indeed, the stores are infinite from which people of all classes can draw materials best suited to their own manner of workmanship, and the present is no ill-fitting season in which to work more earnestly than ever in humanity's great cause.

Whether, with the Pope and the German Emperor, we regard the new year as the first of a new century, or believe it to be the last of the old, it is an excellent time to inaugurate a better kind of life for our dumb fellow-creatures, or to send off the dying century with a promise of that better life.

When the teachers of Great and of Greater Britain decide that the new creed of which we spoke in our last paper (that every sentient being has a right to as much happiness as possible, *because* it is a sentient being) shall be the universal creed of the children, we may welcome the new century, in full belief that before its close the echoes only will be heard of

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Mr. Jackman just reaching home with 7,679 votes, against 7,305 recorded for Mr. Blacker. The record for persistency in fighting is held by Mr. Bowden, who was a candidate in 1887, 1889, 1890, 1891, and 1892. Next to him is Mr. E. Gray, M.P., who offered himself for election in 1890, 1891, 1892, and 1893. He was at that time the head-master of St. Gabriel's Schools, Pimlico, and was neither M.A. nor M.P. To-day his "desk" is at Russell Square, where he holds the post of Secretary to the Education Committee. So much by way of introduction. Let us now turn to the candidates for 1900.

MR. JAMES F. BLACKER

is a Cornishman of energy, ability, and determination. It is a curious and interesting coincidence that he was a pupil

MR. JAMES F. BLACKER.

teacher first in the Central School, Truro, where genial Richard Greenwood had served his apprenticeship, and afterwards in Holy Trinity Schools, Plymouth, where the late C. J. Addiscott, of beloved memory, had been a pupil teacher. He was sixth on the Scholarship List in 1874, and is a bronze medallist and honoursman in science. For close upon twenty-five years he has held the post of head-master of Christ Church Schools, Brighton, where he has done splendid work—the past joining with the present scholars in testifying to the value of his labours, and to his self-denial, self-sacrifice, and enthusiasm in everything appertaining to the welfare of the school. He has been a member of the Union for twenty-two years, has twice filled the chair of his local association, has sat at Russell Square since 1894, and for two years has held the responsible position of Chairman of the Parliamentary Committee. The Baseden case, perhaps, first brought him prominently before the members of the Union. Mr. Baseden had been dismissed by the Brighton School Board because he was no longer able, or because he refused, to grind 96 and 98 per cent. out of the little ones committed to his care. As a protest, Mr. Baseden was adopted as a candidate for a seat upon the School Board. The victory that he won on that occasion, and his success in the competition for the chairmanship of the Board, which came to him in due course, are both matters of history. Mr. Blacker organised the fight, and rejoiced in the triumph that attended his efforts. Since that time he has been responsible for Tenure victories at Shoreham and Southwick. No member of the Union who was present at the Brighton Conference will forget the magnificent success which Mr. Blacker achieved as general secretary, or that glorious function at which the Duke and Duchess of York assisted. If nominations count for anything, he is already elected Vice-President of the Union; for close upon 150 associations have declared he is the man for 1900, and, as we have already pointed out, he ran the victor of 1899 to within 400 votes. At the Executive Board he is most diligent in the discharge of his duties. Nothing escapes him; no detail is too trifling to engage his attention. He is a black and white artist of no mean ability, his little sketches being in great demand amongst his friends both at Russell Square and elsewhere. He has a passion for old china—his collection, by the way, is a very valuable one—he is a sincere friend, a generous opponent, and a gentleman in the highest sense of the word.

MR. HARRY COWARD

is a tower of strength to his brethren in the west. For many years past he has been identified with almost every educational movement in that part of England, working with such energy and devotion that one wonders how it has been possible for him to accomplish so much in addition to his ordinary school duties. He served his apprenticeship at Warminster, Wilts, at the close of which he obtained a first class in the Queen's Scholarship Examination, and entered Borough Road. He again took a "first" in the Certificate Examination, and then had charge of a rural school (Hambrook, Glos.), where he remained six years. The experience he then gained has been of great assistance to him in his endeavours to improve the conditions under which rural teachers are now working.

Leaving Hambrook, he proceeded to Anglesea Place Board School, Bristol, of which he has been head-master for sixteen years. For seven years, too, he has held the post of teacher in English in the pupil teachers' classes (Bristol School Board), and for two years he has been lecturer in English at teachers' classes, University College, Bristol. With all this professional work, he has found time to take a very active part in the affairs of the local branch of the N.U.T. His membership of the Union extends to twenty-one years, for sixteen of which he has served on the committee of the Bristol Branch. He was treasurer for four years, and has twice filled the office of president. He has organised local meetings and public conferences on educational matters, taken a prominent part in deputations to members of Parliament, School Boards, school managers, etc., etc., and done excellent work with his pen in many directions. To give full particulars of his labours, indeed, would require a page or two of this journal. The Schools' Football League owes much to him; the political party to which he belongs has for many years found him an active and successful organiser; he has done good work as secretary to the Bristol Educational Council, founded by Archdeacon Wilson; and he is a member of the Bristol Economic Society. He found his way to the Executive Board of the Union in 1896, and it is not too much to say that he made his mark there almost immediately. As a member of the Education,

MR. HARRY COWARD.

Tenure, and Organisation Committees he has laboured incessantly; he has rendered splendid service as vice-chairman

of the Superannuation Committee, has represented the Union in Scotland, and has conducted many important inquiries on behalf of the Education, Law, and Tenure Committees. His work for the Charities is too well known, perhaps, to need more than a passing reference. From friends—not teachers—he has collected during the past few years nearly £200 for the Funds. For four years he has served on the Central Council at Russell Square, and was chairman of that council in 1898–99.

His ability, his zeal, his perseverance, and his enthusiasm eminently qualify him for the high office which he seeks to fill, and which sooner or later, barring accident, he is bound to fill. The Union has no more faithful servant than Mr. Harry Coward of Bristol.

MR. ALLEN CROFT,

the able and energetic Vice-chairman of the Education Committee, is one of those prophets who are honoured, respected,

MR. ALLEN CROFT.

and trusted in their own country. It is certain that the Nottingham Association has no more popular member than Allen Croft; and well does he deserve his popularity, for he is a man of culture and of dignified bearing, he is a fearless champion of the rights of teachers, he insists upon a professional code of honour, he is as courteous as he is bold, and he is always prepared to spend and be spent in the service of his professional brethren. For close upon twenty years he has been a member of the N.U.T., and for five years a member of the Executive, where his work has stamped him as a man of ability, zeal, and discretion. That his colleagues appreciated his personal worth, skill, and energy is proved by the fact that after he had sat at Russell Square for two years they elected him Vice-chairman of the Education Committee, his chief being the loved and honoured Robert Wild, twice President of the Union. His past training in his local association had so disciplined him that he had not the least difficulty in satisfying his colleagues in this new sphere of labour. For over fifteen years he had been a member of the General and Benevolent Committees; he had served as Secretary of the Organisation Committee for four years, as Chairman of the Provident Society (local branch) from the day it was started in Nottingham, and as President of the local Association in 1894 and 1895.

The great success which attended his efforts in all these departments of Union activity led him and his friends to consider the question of an Executive career. From that time he has never once looked back. He was first elected to the Executive at the Manchester Conference in 1895, when, under the old system of election, he stood fourteenth on the poll, with 6,667 votes. In 1896 he stood sixth, with 10,157 votes, and in 1897 he took fourth place, with 11,193 votes.

Under the system of electoral districts, he has for the past two years represented the North Midland Electoral District, easily heading the poll on each occasion. Mr. Croft has had great experience in deputation work, interviewing members of Parliament, Parliamentary candidates, members of city and borough councils, School Board members and candidates, and representing the Union in Ireland, Scotland, and Holland.

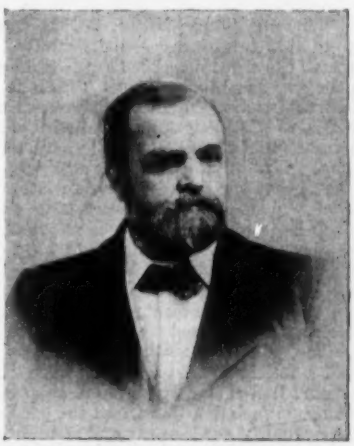
By the way, he had a curious experience on the occasion of his last visit to Holland. At the Conference dinner the regular orchestra inserted into the evening's musical programme "The Transvaal Folkalied." The majority of the members rose and showed sympathy with their kindred in South Africa by heartily singing this and also the National Anthem of Holland. Anxious that the English representatives should not have an uncomfortable moment, the president explained to them that the band on its own initiative had played the selections named. He then called for "God save the Queen," which was given with much heartiness, and the genial Allen breathed again!

One other word. The subject of our sketch is an effective speaker and a keen debater, and from every point of view is a man who would, if elected, undoubtedly uphold the highest traditions of the presidential chair.

MR. TOM JOHN,

"the Prince *in* Wales," as he has been styled over and over again, is the oldest member of the Executive who has not passed the chair. He was elected as far back as 1887 (Portsmouth Conference), so that he has served the Union, in Fleet Street and at Russell Square, for thirteen years. No other candidate at the present moment can lay claim to such a distinction. Do members of the Union ever understand the self-sacrifice involved in the long railway journeys, and in devotion to Union business, extending over a period of thirteen years? That is Mr. Tom John's "record," and it speaks for itself.

The genial Welshman was trained as pupil teacher in one of the oldest schools in Aberdare, under the late Mr. Dan Isaac Davies, the apostle of bilingual teaching in Wales; and he was for two years a pupil teacher under Mr. Walter Hogg, the Secretary of the Glamorgan Technical Instruction Committee. At the close of his apprenticeship, Mr. John proceeded to Borough Road Training College, in which institution he spent the years 1869–70. The great success he has achieved as a teacher has attended him in other fields of labour—notably, perhaps, in the editing of a largely circulated South Wales newspaper. On the Executive he has rendered faithful service, his special departments being the Organisation and Parliamentary Committees. As chairman of the former, he gave particular attention to the Principality, which in point of membership of the Union now compares favourably with any other part of the country.



MR. TOM JOHN.

He has always pleaded for the best educational equipment for Wales, and during the past year has done his best to

wipe off the "bad third" reputation which Dr. Macnamara's speeches and pamphlets have given to that part of the United Kingdom.

He has taken up each county, and, by comparisons with adjacent counties, stimulated largely educational rivalry which will, it is hoped, produce a higher general standard. Much of his time is given to the Central Board and University Court of Wales, and in this connection he has forced the presence of the primary teacher on these national bodies, thereby greatly advancing the recognition of the certificated expert on all councils of education. It may be that the same principle will obtain in the new bodies which the Board of Education will create for England.

Those who know Mr. John—and what Unionist does not know him?—agree that he is heart and soul in every work which makes for betterment in education. His friends claim that his long and disinterested services on the Executive entitle him to the premier honour which the Union can bestow upon its workers. The writer of this sketch has known him for many years, and is prepared to say that the claim is a just one. In every department of Union life Mr. John is an enthusiast, and we trust he will at an early date receive the reward he has earned by long and diligent service.

A PRACTICAL TEACHER AT THE HOLIDAY COURSES.

II. LAUSANNE.

ON my arrival at Ouchy, the pretty little port of Lausanne, I mounted to the town by the funicular railway, and soon found myself in another world—a world of quaint squares, narrow, tortuous streets, steep slopes, among which I grew quite bewildered. A stout, good-humoured German *Studiosus*, whom I interrogated, gave me all necessary information; and I then mounted still higher by the hundred and sixty steps of the Escaliers du Marché, up and up, till I reached the silent quarter of the cathedral and the university, with its deserted streets and its odd-looking, green-shuttered houses. Here I found quarters close to the École de Chimie, the handsome building in which the courses are held. The following day, as there were no lectures, I made the tour of the Haut Lac, and revelled the whole day in the beauties of Vevey, Clarens, Montreux, Territet, Glion, Chillon, etc.; but as I must not write guide-book, I will merely advise future students to follow in my track, and take with them Lamartine's exquisite poem, *Le Lac*, for company. They will need no other. It is a kind of *solitude à deux* for which I have a great liking when in the presence of the majesty of Nature.

The next morning lectures began, and the same privileges I had enjoyed at Geneva were cordially granted me by Monsieur Bonnard, the director. The lectures here are all delivered in the great auditorium of the École de Chimie, and at 9 a.m. I was listening intently, with about one hundred other students, to Monsieur Auguste André, whose lectures were of a most useful and practical character—*Diction et prononciation*. His advice to foreigners was this—to remember that great varieties of pronunciation exist even among cultured people of French-speaking countries, and that too much importance must not be attached to small details. The aim of the foreigner should be to avoid gross faults, exaggeration, and affectation, and to acquire a pleasing, normal style of pronunciation. Monsieur André's remarks upon the Parisian accent would exactly apply to the London accent, if addressed to foreigners studying English; and to me, who have always made the *accent de Paris* somewhat of a fetich, his explanations were "eye-openers." Monsieur André had visited Paris for the express purpose of studying the pronunciation there, and the conclusion he had arrived at was, that in good society and at high-class theatres good models could be heard, but that elsewhere one would hear and perhaps imitate gross faults. Then followed minute directions as to the pronunciation of various sounds, the treatment of *e* mute and the liaisons, in conversation, prose, or poetry, with pattern-reading from the book of extracts.

At 5 p.m. I attended Monsieur Maurer's *conférence pratique*, which consisted of translation from German into French, with study of synonyms, and all kinds of running comments. The lecturer deprecated the too slavish use of the dictionary ("*Les dictionnaires font un mal horrible à ceux qui les consultent*"), and his remarks caused great laughter. He also attaches great importance to the use of suggestive gestures in the struggle for the correct expression. This idea also created great amusement, and some of the ladies in particular seemed to enjoy the "gesture" method immensely. The morning's work here is a series of four lectures, each three-quarters of an hour in duration, with an interval of a quarter of an hour for recreation and conversation after each. It was this *entr'acte* which gave me my first impression of the Lausanne courses. The morning I first appeared upon the scene, a lecture had just ended, and the students were promenading in the wide corridor, jabbering to their hearts' content. Here, as at Geneva, the majority of the students are Germans, although almost every European nationality is represented. My respect for their working powers increased from day to day, when I noticed that after four hours of almost continuous work, their vital energies were still vigorous enough to raise this mighty *brouhaha* of animated conversation in the intervals. While talking of work, I may mention that books relating to the study of French are distributed among the students three times weekly, so that one who is bent upon making rapid progress has every facility here. The next day, at 8 a.m., I heard Monsieur Maurer again, the subject being, *Étude comparative des langues française et allemande*. The main idea of the lecture—namely, that in French the fundamental notion comes first, and in German last—had been reduced to a formula: for French, FC, for German, CF, where C = complement and F = fundamental. Then followed examples of compound words, phrases, and even sentences: *Weingeist* (CF), *esprit de vin* (FC). By a comparison with Latin (*aquilifer*), the professor showed that the German follows the ancient formula—that is, German is at an earlier stage of development than French. The same idea was traced through phrases and sentences even to complete works. But there I did not follow the professor, for the idea occurred to me that most people place the point of an anecdote or the *dénouement* of a novel at the end, and that in such cases, whether we are English, French, or German, we naturally follow the formula CF. After the lecture came translation exercises, in which "gesture" and laughter again played a very prominent part.

The rest of the morning was devoted to contemporary French literature, from ten till twelve (Monsieur André). The subject was Zola and *naturalisme*, and the views of the lecturer were most moderate and sound. These lectures gave me intense pleasure, probably owing to the fact that Monsieur André's opinions on this very debatable subject coincided so exactly with my own. It reminded me of the time when, after reading one of Zola's books, in a state of furious revolt against his sickening pessimism, I always eased my mind by writing a violent criticism of it in French to my chum across the Channel. Zola always struck me as being morbidly melancholy; his favourite phrase is *d'une infinie tristesse;* he looks at the world through darkened spectacles; there are books of his in which one finds no gleam of sunshine, nothing bright, or happy, or noble, or good, from one cover to the other. His creed seems to be, *L'homme est une sale bête*. Monsieur André opines that it is more reasonable to regard man as *ni ange ni bête*. Then the great error of Zola, that science can explain all, that science and labour are all that man requires, is next discussed. Zola says, "*Le monde est aujourd'hui sans mystère;*" but the lecturer endeavours to show that, in spite of the light of science, we are still surrounded by many and great mysteries. He gives a sketch of Zola's great trilogy, Lourdes, Rome, Paris: in the first, the overthrow of Pierre Froment's simple religious faith by the gross, ludicrous miracle-mongers of Lourdes; in Rome, the triumph of reason and science over religion, the uselessness of charity, the crying need of justice; in Paris, the praise of work as the sole

means of making life possible or endurable. Monsieur André is severe upon Zola's faults as a philosopher and a writer: Zola is only a *demi-savant;* a scientific novel, such as he aims at, is ridiculous and impossible; his style is heavy, wearisome, encyclopædic (*trop de papier, il faut moins que ça!*); he gives no real insight into humanity; his characters are unreal and vague.

And now a word as to the lighter side of our subject, the pleasures of a sojourn at Lausanne. At 4 p.m. we assemble on the terrace in front of the École, and while waiting I enjoy the lovely glimpse of the Savoy Alps across the lake, comparing it with the magnificent views I have had in my pleasant rambles to Montbenon, the Signal, etc. Then the professors appear on the scene, and off we go. During the walk I have a pleasant chat with M. André on our pet subject, Zola; with M. Bonnard on the general arrangements of the courses; and with M. Maurer upon English life and English universities, of which he seems to have learned a great deal in his travels. Then we reach the Bordage, where we sit down upon a terrace overlooking the lake, drink beer (*se mouiller le gosier* is the phrase), sing Swiss songs, and chat and laugh. The weather is lovely—cool, cloudy, with gleams of sunshine. The mountains and lake are marvellous in their ever-changing play of colour, light, and shade—peaks cloud-topped, rocks gleaming out in patches of bright sunlight, the lake shimmering in all the tints of green and blue and violet. Such was the scene of our merry evening ramble. Then back along the shore, up to the quaint old town again by the funicular, and home through the winding climbing streets, where smiling Vaudoises are chatting with their swains in picturesque groups that fill the narrow way.

Monsieur Millioud's lectures (*Questions d'école et de psychologie*) only commenced on the last day of my stay, so that I heard him only once. His subject aroused my interest immediately—"Fatigue." In these days of feverish activity, of over-excitement, and *surmenage*, we are all of us more or less personally concerned in this question of fatigue. The professor, after defining psychology as *l'étude de la sensibilité chez tous les êtres vivants*, plunged at once into his subject, showing that fatigue was really a form of *poisoning*, the poisoning of the tissues by the waste matter produced in all effort, physical or mental. He then detailed various experiments performed upon that luckless creature the frog with a view to proving this. Next followed an account of Nature's safeguards against fatigue, which we pedagogues see so plainly at work in the case of the average British schoolboy—namely, inattention, absence of mind, working by fits and starts (*travail par saccades*). To show the various forms and phases of fatigue in different subjects, the professor drew upon the blackboard graphic "curves of fatigue," registered by an indicator called the *ergograph*, afterwards discussing different types of recovery from fatigue (*restauration*), and the laws which govern the *travail d'un muscle*. He pointed out that the intensity of effort does not necessarily follow the same curve as the fatigue, and that when great effort and great fatigue co-exist the result is pernicious to the subject. I quitted the lecture-room with strange visions of the psychological expert of the future, visiting our schools with his perfected *ergograph*, experimenting upon our boys instead of upon the poor frog, classifying, labelling, cataloguing them according to their types of fatigue, effort, and restoration—according to their capability of pursuing higher studies, or their Rip Van Winkle-like capacity for doing a minimum of work in a maximum of time.

There yet remain many details of the work of the lecture-room which I would like to describe, but which must perforce be passed over hurriedly. M. Maurer one morning enumerated a multitude of methods for improving one's grip of a language—for example, contrast (*eau claire, eau trouble*); comparative study of proverbs, home and foreign; meanings, literal and figurative; the whole and its parts (*alvéole, ruche*); periphrasis (*ville aux jardins suspendus = Babylone*). Then there were newspaper readings, with analyses of articles by Clémenceau and Anatole France, and interesting allusions to the Dreyfus case; the decline of naturalism and the rise of idealism in France, etc. The lectures and discussions on contemporary French literature dealt with men like Daudet, Guy de Maupassant, frères de Goncourt, Coppée, Brunetière, etc. On one occasion a question of mine elicited from M. André most useful hints on the correct style of reading French poetry, with its rhythm so feeble and yet so musical.

But although I have omitted so much, and although there were some professors whom I did not hear at all, yet I have probably described enough detail to give readers of THE PRACTICAL TEACHER some idea of the intellectual stimulus, the charming variety and novelty, which they may enjoy by taking part in these courses. I only regret that it was impossible to find time for my intended visit to Neuchâtel; but a letter and full information, kindly sent to me by Monsieur le Dr. P. Dessoulavy, indicate plainly that the work there is conducted upon similar lines, with a section for less advanced students. Indeed, he says expressly in his letter, "*Les cours ont un caractère essentiellement pratique.*" It is to be noted that the number of students at Geneva was 150, at Lausanne about 100, and at Neuchâtel a much smaller number, namely, 40, divided into two classes. Therefore those who are well advanced in French, and prefer a lively town life, with the varied society of a large company of fellow-students, should certainly choose Geneva. The student quarter of Lausanne is very quiet—an admirable place for the earnest *piocheur* who is anxious to make rapid progress. In both towns delightful excursions upon lake and mountain can be arranged, and work and pleasure can be combined in whatever proportion the student prefers.

But the special advantage, in my opinion, is the intercourse with teachers of all nationalities—the pleasant consciousness that for the time being one is not merely an Englishman, but a citizen of the world, now chatting to an Italian about the "Eternal City," now with a Hungarian lady about Kossuth, now with a Swede about the "Venice of the North." If the student attends courses nearer home, say in Normandy, he finds that nearly all his fellow-students are English, and he has his little insular world around him all the time. In Geneva and Lausanne he need not speak English at all. He finds himself in a bright focus of international life and thought and intellect; his sympathies widen with his mental horizon; he learns to recognise that his own great nation is only one of many great nations; amid these striving students of many lands he forms clearer notions of the complex, mighty, far-reaching efforts of humanity; subjects of the widest, deepest, intensest interest open up before him; he begins to realise what an intensely puzzling, intensely fascinating thing is human life; and in his more thoughtful moments he can catch the mighty heart-throb of the world.

SOME DUTCH NAMES AND TERMINATIONS.

(From T. Nelson and Son's Transvaal War Atlas.)

Afrikander, a white man born in South Africa of European stock.
Berg, a mountain, as in Heidelberg.
Boer, a tiller of the ground. The name is commonly applied in the plural to the whole of the Dutch population.
Burgher, a European male in possession of the franchise, and liable for public duty.
Commandant, a military leader. *Commandant-General*, the head of the military.
Commandeer, to call out for military service.
Commando, any body of burghers called out on military duty.
Dopper, the Puritanical, ultra-Conservative, and more retrogressive sect of the Boer Church.
Dorp, village, as in Krugersdorp.
Drift, ford, as in Rorke's Drift.
Field Cornet, a sort of sub-magistrate of the Transvaal, exercising ill-defined powers, mainly military.
Fontein, a spring, as in Bloemfontein.
Hollanders, Dutchmen from Amsterdam. They occupy many of the most important posts in the Government service.
Inspan, to harness or yoke. *Outspan*, to unharness; to halt.
Kloof, a ravine or declivity on a mountain.
Kop (or **Kopje**), a hill, as in Spetz Kop.
Lager (or **Laager**), an enclosure set up for protection, frequently made by lashing wagons together.
Landdrost, a stipendiary magistrate who administers justice and receives the revenues of the district.
Nek, an opening, as in Laing's Nek.
Poort, an opening between mountains, as in Komati Poort.
Rooinek, English "red neck;" the Boers' name for an Englishman.
Sluit, a ditch.—**Spruit**, a stream, as in Bronkhorst Spruit.
Stadt, a town or village, as in Kroonstad.
Trek, an exodus or emigration.—**Veldt**, an open plain.
Volksraad, the people's council.
Zarp (Z.A.R.P.), the South African Police.

Our Monthly Retrospect

EDUCATION IN ENGLAND.

N.U.T. NOTES, ETC.

BY T. B. ELLERY, F.R.G.S.,

President of the National Union of Teachers, 1895-96.

The Tenure Question again. No apology, perhaps, is needed for once more bringing the tenure question under the notice of the readers of this journal. It is quite clear that dismissals will go on, and grave injustice be done, until the British public really understands the whole position. One of the latest cases is that of Ringstead, near Hunstanton. Here the teacher has done excellent work, and he is exceedingly popular in the parish. Yet he is dismissed by the school managers. No "reasonable and assigned cause" came before the Tenure Committee of the Union, and all efforts to obtain one failed. A member of the Executive visited the spot, made the fullest inquiries, interviewed members of the committee, and did all that was possible to bring about a friendly settlement; but his efforts failed, for those most responsible refused to budge! Then a memorial to the committee was started, and was extensively signed. Practically the whole of the villagers wrote their names upon the sheet. To this the committee replied that no useful purpose would be served by the presentation of such a document. Finding, therefore, that no friendly measures had any chance of success, the Executive declared war, and sent Mr. Organ and two members of the Tenure Committee to Ringstead to attend an indignation meeting of parents and ratepayers.

The Ringstead Indignation Meeting. By poster and handbill a "Public Meeting of Ratepayers, Subscribers, Parents of Children, and others (Ladies specially invited)" was announced to be held in Mr. J. Grange's barn on Friday evening, January 26, "to protest against the action of the School Committee in dismissing Mr. A. Shepherd from his post as head-master of the Ringstead C.E. Schools." The barn was full—at least two hundred people attending, to show their sympathy with the man who had done so much for them and for their children. The writer of these Notes has had considerable experience in Union tenure cases, and has witnessed many gratifying exhibitions of respect and esteem on the part of the parents towards the dismissed teacher, but he has never seen quite so unanimous a support as that given by the good people of Ringstead to their friend Mr. Shepherd the head-master.

Mr. J. W. Beeton (County Councillor) took the chair, and both in his speech and in his conduct of the meeting showed that he was just the man for the post he occupied. Mr. Organ gave his views on the legal and Charity Commissioners' aspect of the case, Mr. Bowers followed with a statement of the details of the dismissal, and the present writer wound up from a Union and general standpoint.

All the resolutions were carried unanimously, the utmost enthusiasm prevailing.

The Resolutions. The following were the resolutions adopted by the meeting:—

"1. That the inhabitants of Ringstead in this meeting assembled fully approve of the action of their Parish Council in applying to the Charity Commissioners for an order establishing a scheme for the proper management of their parish schools.

"2. That the inhabitants of Ringstead in this meeting assembled hereby testify to the high esteem in which they hold Mr. Arthur Shepherd, and to his excellent personal and professional character.

"3. That the inhabitants of Ringstead in this meeting assembled hereby express their dissatisfaction with the action of the Acting Committee of the Ringstead Schools in their purported dismissal of Mr. Shepherd."

The Veteran Mr. Graves. Members of the Union in all parts of the country very deeply regret the decision of Mr. Graves, former President of the Union, not to offer himself for re-election in 1900. He was the President of the Union in the first year of its existence, when the number of associations was twenty-six only, and the total membership only four hundred. This was at a time, too, when membership was *free*. He has lived to see the number of associations run to between four and five hundred, and the membership to considerably beyond forty thousand. During all the intervening years he has had a seat upon the Executive, retiring annually, and annually being re-elected. When one remembers that he has never received a farthing for his services, either directly or indirectly, and that, indeed, in the early years *he paid his own travelling and hotel expenses* (in common with other members of the Executive at that time), one cannot fail to be struck with his devotion to the teacher's cause. Of late his state of health has been such as to compel him to consider his position, the travelling, the late hours, etc., and he has come to the conclusion that he must retire. That he will be missed goes without saying. He is a man whom to know is to love. It is certain that he hasn't an enemy within the ranks of the Union. His hold upon the respect, ay, the affection of the members, is as great to-day as it was twenty or thirty years ago. The Executive will not be the same without him, and there will be a gap which no other man can fill.

The suggestion to present him with a testimonial in acknowledgment of his splendid services is one that deserves unanimous support. There is a further suggestion to make him a life member of the Executive. This proposal also deserves careful consideration. The principle of "life members" on such bodies is open to grave objection, but in this case no harm could possibly be done; there need be no talk of "establishing a precedent," and the concession would be a handsome tribute to the veteran's self-denying labours for the past thirty years. Dear old friend, J. J. Graves! May the evening of life have many pleasures for thee, and may the God of all mercies have thee in His gracious keeping!

The Executive Election. In the last issue of THE PRACTICAL TEACHER a complete list of nominations for the Vice-Presidency and the Executive was given. Since that list was compiled the following gentlemen have retired:—

From the *Vice-Presidency* contest, Mr. F. Peaker of Leeds. Mr. Peaker is still, however, a candidate for the Executive, and as he has done such excellent work for the Union in so many different ways (notably, perhaps, as chairman of the Union's Finance Committee), there ought not to be the least doubt as to his return.

From the *Executive* contest—District No. 4, Mr. J. Smith; District No. 7, Mr. G. T. Apps; District No 8, Mr. A. Winfield; District No. 9, Messrs. J. W. Lewis, T. Thomas, W. Tegarty, W. Brockington, and E. C. Willmott. The last mentioned has already served with credit to himself at Russell Square, and one is exceedingly sorry to hear that considerations of health compel Mr. Willmott to give up the work which, it is well known, has great attractions for him.

Circular 439. This is a circular from the Education Department to School Boards and School Attendance Committees, and

NEXT MONTH:

THE COMMON SCHOOLS OF RUSSIA.

By a Special Correspondent.

is entitled "Age of Exemption from School Attendance." In it "My Lords" call the attention of all local authorities under the Education Acts to the alteration in the law of school attendance made by the "Elementary Education (School Attendance) Act, 1893, Amendment Act, 1899 (62 and 63 Vic., c. 13)," which came into operation on the 1st January last.

As every one knows, the effect of the Act, briefly stated, is to raise to twelve years the minimum age for total or partial exemption. That being so, those concerned are instructed that where the by-laws now in force allow total or partial exemption at eleven years of age, the said by-laws must be altered, and twelve substituted for eleven. There are, however, two important provisos to section 1 of the Act which materially affect the law of compulsory attendance. To these special attention is directed :—

"1. Provided also that the local authority for any district may, by by-law for any parish within their district, fix thirteen years as the minimum age for exemption from school attendance in the case of children to be employed in agriculture, and that in such parish such children over eleven and under thirteen years of age who have passed the standard fixed for partial exemption from school attendance by the by-laws of the local authority shall not be required to attend school more than two hundred and fifty times in any year.

"2. Provided also that a child shall be entitled to obtain partial exemption from school attendance on attaining the age of twelve years, if such child has made three hundred attendances in not more than two schools during each year for five preceding years, whether consecutive or not."

What will our rural friends say to all this? It would be interesting to have the opinions of such representative men as Mr. R. R. C. Gregory and Mr. F. B. Gale. Conference will in all probability say some very strong things; in the opinion of those well qualified to judge, the stronger these are the better.

The Superannuation Act. It is understood that the Executive proposals *re* the "Old Guard" have not satisfied *all* the teachers concerned. But to sit still and do nothing would be a very unwise step to take, and the Executive, therefore, is well advised in deciding to carry out its plans and to ask the Education Department and the Treasury to receive a deputation. With respect to the Act itself, it is quite true that the provision made is not a generous one; still, Sir George Kekewich was quite right when he said, the other day, that the Act would be a boon to a very large number of teachers whose salaries have been low, or comparatively low. Already many letters of thanks from teachers who are retiring from active work are being received at Russell Square. These are specimens :—

1. "I take this early opportunity of thanking you most sincerely for the unselfish interest you have taken in the matter."

2. "To yourself and others who worked so well to get the Act passed I return many thanks."

3. "My husband wishes to thank you and the members of the Executive who did so much towards getting this boon for old and disabled teachers. Words cannot express the relief it is to be thus rendered independent of charity."

4. "God bless you for your help in the matter of my pension."

The Executive will, of course, go on with their good work, and endeavour to secure improved terms. One step will be taken at the York Conference, when two resolutions dealing with the subject will be moved.

The York Conference. Mention of the York Conference leads us to make inquiries as to the subjects to be discussed. These will include—Attendance at School, Attendance under the Robson Act, Curriculum of Schools, Discipline in Schools, an Educational System, Employment of Children, Examinations, Extraneous Tasks, Financial Aid to Schools, Grants, Higher-Grade Schools and Schools of Science, Rural Schools, Salaries, Staffing, Superannuation, Tenure, Training and Certification of Teachers; and these by no means exhaust the list. In the private sessions much important business will be transacted, including the Executive proposal to found "Addiscott Scholarships," in memory of a man whom the Union during his lifetime delighted to honour. This is the proposal: "An exhibition of £25 shall be awarded to the boy pupil teacher who takes the highest place in the Scholarship Examination, and an exhibition of £25 shall be awarded to the girl pupil teacher who takes the highest place in the Scholarship Examination, provided that such pupil teacher shall proceed to some training college. The conditions may be varied from time to time as the Executive of the National Union of Teachers may determine, but at least twelve months' notice will be given of any alteration." Other matters to be discussed will be an honorarium for Mr. Hamilton (the hon. treasurer), the organ of the Union, Parliamentary representation, presentation to Mr. Graves (who is retiring from the Executive after thirty years' work), qualification for membership, Conference representation, superannuation of officials, Sustentation Fund, etc.

The New Premium Assurance Committee. The Executive having asked the Teachers' Provident Society to undertake the work connected with the assurance of premiums under the Superannuation Act, a new committee has been formed, one half the members being officials connected with the Provident Society, and the other half being members of the Executive. The first meeting was held on Friday, February 2, when a chairman and vice-chairman were appointed, rules considered, and applications received.

A capital start was made, and it is safe to say that many teachers will avail themselves of the terms offered. There are two schemes under which members of the Union may assure, to both of which reference will be made in these columns at an early date. In the meantime, those interested should apply to Mr. Golding, 71 Russell Square, who will gladly send a prospectus giving details of the new departure.

TECHNICAL AND SECONDARY EDUCATION.

Assistant Masters and Tenure in Secondary Schools. The following are the views of assistant masters in secondary schools in respect to tenure, as presented to the candidates for the representation of the London University in Parliament :—

That it is desirable that a Bill should be introduced into Parliament to secure for head-masters and assistants on dismissal an appeal to the Board of Education, acting through the Consultative Committee.

That head-masters of endowed schools should be responsible to some outside body for the large powers they possess under the Charity Commissioners' schemes, especially in connection with the dismissal of assistant masters; approval and disapproval alike should be subject to the approval of governors.

That, if possible, the local authorities should be so constituted that it would be possible to move teachers from one school to another in the same area, in those cases in which the members of a staff do not work well together.

That in all endowed schools, and schools aided by public money, the salaries of the assistants should bear a ratio to that of the head-master which is more equitable than obtains in many of our large schools.

That it is desirable that a series of returns to Parliament should be moved for on the subject of the management and condition of educational trust funds.

These demands are extremely moderate, and, so far as they apply, are at work under the London School Board at the present time.

"Intellectual Education," by Professor Sully. An admirable course of twelve lectures, with the above title, has been arranged by the College of Preceptors for Thursday evenings, and commenced 22nd February. Secondary teachers in schools and acting elementary teachers will find the syllabus well suited to their requirements, and by regular attendance at the lectures they can secure teaching of a superior character from one of the greatest of modern educational experts.

Commercial Education. The scheme of the Technical Education Board of the London County

Council for the provision of commercial education is in operation. The school is located at University College, Gower Street, the Board giving £400 and half the master's salary as an annual contribution. Mr. Kahn, who has spent some time studying commercial methods on the Continent, is in charge. Twenty scholarships are offered by the Board to boys of fifteen years of age, consisting of free education, books, and a maintenance grant for each, varying from £20 to £30 a year, in the three years for which the scholarships are tenable. The syllabus is above the reach of ordinary elementary school children.

Ten Years' Growth of Secondary Education. Since 1889 eighty-one new public secondary schools have been established, and two hundred and fifteen improved and extended, for the purpose of science teaching. This extension means the addition of two hundred and fifty-one physical and chemical laboratories, seventy-seven manual-training rooms, seventy-six lecture-rooms, and fifty class-rooms—costing £764,449. Of this sum local authorities have provided £147,496, the rates yielding £20,707, and the rest has come from imperial sources.

Technical Education. Taking technical and secondary schools together, as many as six hundred and sixty-four schools have been affected by the efforts of County and County Borough Councils and other municipal and responsible authorities. Three hundred and eighty-five schools have been or are being established, and two hundred and seventy-nine existing schools have been or are being extended or adapted. The capital expenditure incurred for these purposes now reaches in the aggregate £3,302,221. There are now twenty-eight counties and nineteen county boroughs recognised as the authority for secondary education under Clause VII. of the Science and Art Directory—the authority being the Technical Education Board rather than the County or County Borough Council. It is to be noted that, in proportion to the number of children provided for, the expenditure for technical and secondary schools during the past ten years has been greater than that for primary schools in the same period.

Dr. Wormell and Registration of Teachers. By an unfortunate circumstance Dr. Wormell was prevented from reading his paper at the Conference of the Teachers' Guild held during the Exhibition at the Imperial Institute. It has now been published, and the following is his summary of the requirements for the registration of future teachers:—

1. An academical training equivalent to that for a degree.
2. Evidence of the study of education, and of trained skill in teaching.
3. Provisional registration for those partially qualified, whose names and schools should be recorded in a register of probationers—the names of the probationers to be transferred to the permanent register after two years, or to be omitted altogether, according to the recommendations of the inspectors' report.
4. Increase of aid to intending teachers supplied by the universities.
5. Better provision for a third-year's course of training.

It will be noted that Mr. Oakeley said a pass in second year's mathematics at the training colleges was quite equal to that for a pass degree, and that the standard in some subjects was much higher. Every trained teacher can give the evidence required in No. 2. Little objection can be taken to No. 3, if applied only to future teachers. The Government on February 9 refused No. 4; and as yet, owing to the deficiency in the number of training colleges, No. 5. is impracticable.

Leaving Certificates. The need for co-operation between educational associations is admirably illustrated by a head-master, writing in the *Journal of Education* for February. At the beginning of this term he had a "form" working for the London Matriculation, others for the Oxford Junior Local, and still another for a classical scholarship, each taking separate set books. Besides these, he has at various times to help boys to work for scholarships in mathematics, classics, science, for the Army and Navy, Indian Police, and other examinations, held at various times, and utterly dislocating the work of the school. Simplification is absolutely necessary. There is as much competition between the examining bodies as between various schools. A conference is needed to assimilate these examinations, so that the qualifications may be similar, and the results equivalent, and considered such. The establishment of the Scotch Leaving Certificate is showing how to provide a common ground for unification. To be of service a leaving certificate should have a good base of compulsory subjects, ensuring a thorough general education and a large range of optional subjects, which should make it acceptable as the entrance to the universities and professions.

Training in France. A French Commission on Secondary Education has just reported. The Commissioners have made it clear that they consider the training of the secondary teacher essential to the welfare and continued prosperity of the republic. They recommend a probationary period for every teacher, a *certificat d'aptitude professionelle* for all *agrégés*, and an *école normale supérieure* that shall be a *véritable institut pédagogique*. These recommendations are on the lines of those of the English Commission. It will be interesting to note which of the countries the soonest realises the ideals of its experts.

EDUCATION IN SCOTLAND.

E.I.S. NOTES, ETC.

BY JAMES PATERSON,

Ex-Vice-President of the Educational Institute of Scotland.

Superannuation. Readers may be reminded that acceptance of the Superannuation Act must be notified to the Scotch Education Department not later than March 31. The Superannuation Committee of the E.I.S., through its convener, the president, has made a final appeal to all teachers who are eligible to accept its terms.

Attendances in Advanced Departments. The Scotch Education Department has intimated that the attendances of such pupils as may obtain a merit certificate at the examination by H.M. Inspector may be transferred from the registers of the senior to those of the advanced department as from the beginning of the school year.

Physical Exercise. The spirit of the times is seen in a circular which has been issued by Sir Henry Craik, acting on the instructions of Lord Balfour of Burleigh, on the subject of physical exercise. The subject is stated to be one of great public importance, and, in his lordship's opinion, it concerns not less the interests of the pupils of state-aided schools than the welfare and security of the empire. The circular, after pointing out the great advantages of physical training from an educational point of view, goes on to say that the main object can best be attained by the action of school managers in combination with local associations. Such associations, he thinks, might aid in providing the most simple and essential elements of military drill, and in the formation of cadet corps for those who have just left school. The thoroughness of the physical training is in future to form a very important element in testing the efficiency of a school.

The late Mr. Mason, Dalmeny. The teaching profession has lost many well-known and highly-valued members lately, and not the least amongst them is Mr. David Mason, F.E.I.S., schoolmaster of Dalmeny for nearly thirty years past. Mr. Mason was one of the best known and most highly-respected members of society in West Lothian. In addition to being Schoolmaster, he was Registrar and Inspector of Poor for the parish. His duties consequently brought him into intimate contact and relationship with every member of the community, and few had a wider circle of friends. He took an active interest in the work of the metropolitan branch of the E.I.S., and a few years ago held the position of its president.

Retiral of Perthshire Teachers. Mr. James Thomson, head-master of Kinnoull Public School, and Mr. Robert Gray, head-master of Auchterarder Public School, having recently retired from active duty, were entertained by the Perthshire Branch of the E.I.S. to a complimentary dinner on the occasion. Both gentleman have served their

respective communities faithfully and successfully for a very long period of years, and each, in replying to the toast of his health, gave many interesting reminiscences—the latter remarking that, after long wandering, educationists had come back almost to the exact spot whence they had set out, the new Code being essentially the principle of the old parish school system greatly developed.

Nature Knowledge. At the February meeting of the Edinburgh Branch of the E.I.S., Mr. G. F. Scott Elliot, Professor of Botany in the Technical College, Glasgow, read a paper on "Nature Knowledge." The lecturer was strongly of opinion that, in teaching this subject, text-books should not be used as such, but simply as books of reference. Generally speaking, he was inclined to think that quite the reverse system was adopted: teachers began with the book, and then turned from it to nature, to try to find out some of the things they had read about. As he understood it, the spirit of this course of nature education was to develop the faculty of observation. He sketched a suitable course of lessons, and advocated outdoor excursions as the best, and indeed the only thoroughly satisfactory, method of instruction in this subject.

Colonial Appointment for a Scotch Teacher. Mr. Jerome Wallace, head-master of the Canonbie Public School, Dumfriesshire, has been appointed by the Canadian Government to be organiser and instructor of the Sloyd system of training children in Canada. Mr. Wallace is considered one of the best authorities on the subject in this country, having thrice visited Sweden and studied it on the spot. He is also known as the author of a very complete and popular course of *Woodwork for Schools*, to be followed immediately by a practical manual on *Timber and Tools*, both published by Messrs. T. Nelson and Sons. His friends wish him every success.

Presentation. Amongst the younger generation of teachers no one is better known, or more highly respected, than Mr. Hugh M'Callum, M.A., of the Glasgow Pupil Teachers' Institute, who was lately appointed head-master of Shields Road School, under the Glasgow School Board. Advantage was taken of the occasion by the staff and students of the Institute to present Mr. M'Callum with a gold watch and a number of valuable books as a proof of their good wishes.

Conversazione of Dundee Branch of E.I.S. The annual conversazione under the auspices of the Dundee Branch of the Educational Institute of Scotland was held recently. It was largely attended, and passed off most successfully. The chairman, Mr. John F. Macdiarmid, delivered a short address. Referring to the overcrowding of the school curriculum, he said that the amount of work required to be done by teacher and pupils in an upper standard had practically been doubled within the past eight or nine years. This was owing, in the first place, to the great amount of work to be covered in each subject, but more especially to the gradual introduction, year by year, of one and then another additional subject—a little bit added to the arithmetic one year, some additional geography the next, history dropped out one year, and science put in its place, only to have history reinstated the year after, with the science in addition. Then there were manual instruction for boys, cookery for girls, and drawing for both boys and girls. They had now reached a point where he thought they as teachers should pause, and acknowledge that, if the necessary high standard of instruction in the fundamental subjects were to be maintained, they must not only stop adding to their list, but consider whether it was not highly necessary to drop one or two of the subjects which they at present professed, and which, in his opinion, were of little or no practical utility in after-life to eighty per cent. of the pupils attending ordinary Board Schools.

Drawing. The following deliverance on the subject of Drawing has been given by the Scotch Education Department: "Drawing beyond the Junior Division need not be taken during the first year, with the exception that the construction of simple scales should be taught to the boys who are in the Advanced Division for other subjects."

NOTES FROM THE NORTH.

The late Dr. Ross. By the death of Dr. Ross, for over twenty years Principal of the Established Church Training College, Glasgow, the Educational Institute of Scotland in particular, and the cause of Scottish education in general, have sustained a great, an almost irreparable loss. For many years he has been so closely associated with the Institute, that we had come to look upon his work and labours in its behalf as almost a *sine quâ non* of its existence. In season and out of season he has laboured to promote the welfare of education and of his professional brethren. In him the Highlands and Islands of Scotland found a true and genuine friend; in him the union of the practical and the visionary were so harmoniously blended that many of the schemes he outlined have become practical realities. He spent his life in—he shortened his life through—his devotion to the interests of the Institute.

How are the teachers of Scotland going to perpetuate his memory and work on their behalf? By some it has been suggested that a bust might be obtained, which might be placed in the hall of the college over which he so long presided. But we are strongly of opinion that some other means more useful to the interests he sought to serve might be adopted. Many teachers find considerable difficulty in keeping abreast of the times in the matter of information; this is especially the case with our rural teachers. Would it not be more in accord with the usefulness of Dr. Ross's life if a library were established? Surely there could be secured a building in which such a boon to country teachers might be suitably housed either in Glasgow—the scene of the latter part of his labours—or in Edinburgh, the headquarters of the Institute. The Moray House Club, I understand, have in large measure carried such a project into effect, and the Institute surely could do something in such a matter. In this way I think the Institute, in which Dr. Ross had so many friends and warm admirers, would do much to further the aims he had, and in his death Dr. Ross would still be a source of inspiration and encouragement to the younger members of the profession.

Commercial Education. It has been held by many that the annual congresses of the Institute do little to form public opinion with regard to the subjects there discussed. This, however, has been more than disproved in connection with the recent Edinburgh Congress. Councillor J. Harrison, Chairman of the Edinburgh Chamber of Commerce, gave a very valuable paper on "Commercial Education," a brief summary of which I gave in last month's PRACTICAL TEACHER. As a result largely of the interest thereby aroused, a very important discussion on the subject took place at the monthly meeting of the Merchant Company, an institution which has done very much to increase the facilities for secondary education. The following motion was proposed and carried:—"That the Company remit to the Master, Treasurer, and Assistants to consider the subject of commercial education, with power to take such action as they may deem proper in support of the movement for rendering that department of instruction more efficient and extended, and to report." The question aroused considerable interest, and *The Scotsman* was inundated with very many letters to the editor on the subject. I have great hopes that fruit will very soon be borne, and that the Edinburgh Congress will thus have contributed not a little to the improving of the education given in many of our schools. The Institute, it is to be hoped, will help in the matter, and by its assistance will again demonstrate that it is keenly alive to every phase of our educational machinery.

Dearth of Male Teachers. I had occasion in my recent Notes to call attention to the increasing difficulty that was being experienced by School Boards in securing male teachers. I pointed out that the difficulty was a very pressing one; but through the courtesy of a great number of correspondents throughout Scotland, I am now in a position to state that the difficulty is increasing to an alarming extent.

Vacancies advertised at £80 find no applicants whatever, while £90 is now in the same plight. One correspondent

writes: "This Board advertised for a male assistant at £95, and received no applications, with the result that a female was appointed." Another writes: "This Board advertised at £100, and no application was received." Another informs me that there is not a male teacher within a radius of six miles.

The effect upon education may be realised from the following note: "This Board advertised a vacancy at £85, and received no applications, with the result that they advertised for a male ex-pupil teacher at £40, and a female ex-pupil teacher at £35."

There seems to be but one solution, and that is the raising of the maximum salary. This is borne out by the remarks of one correspondent, who informs me that his Board offered for two vacancies the salary of £80, rising to £110, and they received only one application. Immediately they re-advertised with the scale altered—from £90 to £120—they had several applications.

The state of matters calls urgently for the attention of educationists; and though little will be done, it is felt, until the new School Boards are elected, yet there is something to be accomplished in the interval.

AN EDUCATIONAL EXPERIMENT AT THE ANTIPODES.

BY F. A. CAMPBELL, M.C.E.,

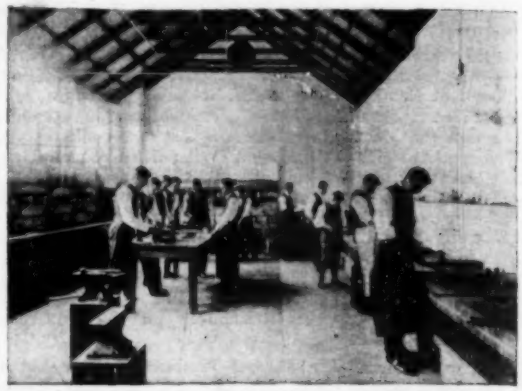
Director, The Working-Men's College, Melbourne.

TWELVE years ago, there was opened in Melbourne, the capital of Victoria, an educational institution upon new lines. A Working-Men's College had been successfully at work in London previous to that date, but in Victoria such a thing was unknown. Most of those who took sufficient interest in the movement to notice it at all, said that the working-men did not want to be educated, that they would not attend evening classes, and even if they did, the result would only be to make them discontented, filling them with ideas above their position. Even the founder, the late Mr. Francis Ormond, was modest in his expectations. "If in two years' time," he said, "there are two hundred students in attendance, I will be satisfied."

A portion of the complete design was first erected at a cost

MAIN BUILDING, LATIOBE STREET.

of about £12,000. The original committee, having it in their minds that the working-man would come straight from the workshop to the college, made extensive arrangements in the way of lavatories, with a dining-room and kitchen. The classrooms were mostly small, several of the larger ones being marked upon the plan as workshops.



FURNACE ROOM, METALLURGICAL LABORATORY.

In May 1887 the present director was appointed secretary, and intending students were informed that enrolments would be received. A month later classes were started. The result was astonishing. In the first quarter nine hundred students enrolled. Class was added to class, new teachers appointed, new subjects added; and the building, which had been thought far too large for the purpose, proved within three months to be ridiculously small. Three years after the institution opened, a deputation from the council waited upon the Premier of the colony and asked him for a grant for new buildings, informing him that there were over two thousand students attending the College classes. A grant of £15,000 was secured; and a block of buildings, double the size of the first, was erected, in which were provided workshops for the plumbers, engineers, carpenters, coach-builders, painters, with studios for art classes above.

It was discovered not only that the young men of Melbourne wanted technical education, but that the young women wanted it also; and, in spite of the masculine name of the institution, they flocked in crowds to it, demanding instruction not only in literary and art subjects, which they received along with the men, but in subjects specially their own, such as cookery and dressmaking. Another point soon became evident after the opening—namely, that the young artisan did not desire to be washed and bathed and fed at the College. He preferred to go home after his work, clean himself, dress, have his tea, before spending the evening in the classrooms or workshops of the College.

The fees were fixed at a low rate—from five shillings to ten shillings per quarter, with half-price to those under eighteen.

For many years all the work was arranged for the evening, between the hours of 7 and 10 p.m., with the exception of a few classes on Saturdays. In this way it was possible to secure the services of a large and able staff of instructors at a comparatively low rate of remuneration. Gradually, however, day classes were added, until now almost every subject can be taken up during either the day or the evening. The last development in this direction, and a very important one, was the establishment, two years ago, of complete day courses, extending over four years, in mechanical, electrical, and mining engineering, and metallurgy. For these the fees range from £3 to £8 per quarter, and the instruction is of a high order.

The last department to be added to the College work was that of printing, in connection with which both the theory and practice of the trade are taught. Machinery of the latest type is supplied, and the printing required in the establishment is done by the class. A quarterly publication issued by the College is also produced in the printing room. The cost of fitting up the room with the necessary plant set was about £160, of which the Government gave two-thirds.

The department of mining and metallurgy is also of recent

date, the laboratory having been completed only last year, at a cost of about £1,000 for building and fittings. It comprises a furnace room, volumetric laboratory, and balance room—the view given (see Fig. 2) being that of the students at work in the former.

The total cost of the buildings and fittings of the College up to date is about £53,000 sterling, of which the Government has given rather more than half, the rest having been raised by private subscription, Mr. Ormond's donations totalling about £15,000 sterling. At the present time £6,000 more has been provided by Government for an extension of the workshops, and it is proposed to erect a large engineering shop fitted with machinery and tools, a blacksmith's shop, and a foundry. A new wool room is also part of the scheme. Wool-sorting is now taught in an upstairs room of one of the present buildings, but the accommodation is very inadequate. A view of this department is given in Fig. 3. The new room will be fifty by forty feet, with a top light; and a museum of wool samples will be an important feature of the new establishment. There are generally some thirty to forty students studying here, the course extending over two years. There is ample opportunity in the way of openings for good wool-sorters in Australia. The next extension of the College work will probably be in the way of training for those engaged in tanning and dyeing leather. Melbourne manufactures and exports great quantities of leather of the commoner kind, but technical knowledge is required to enable her manufacturers to compete with those of America and Europe in the finer kinds.

The cost of maintenance of the institution, whose pupils

A CORNER OF THE WOOL ROOM.

are about 2,000 in number, ranges from £7,000 to £8,000 per annum—the revenue being derived from students' fees, about £4,000, and Government subsidy, £3,600 per annum. There are practically no private subscriptions, and the Town Council does nothing towards helping to provide technical education for the citizens.

To give some idea of the extent of the operations of the College, it will suffice to say that there are in all nine departments — namely, literary and commercial, mathematics, engineering (mechanical, mining, electrical), mining and metallurgy, chemistry, architecture, art and applied arts, domestic economy, and rural industries. Theoretical and practical instruction is also given in the following trades: carpentry, coach-building, plumbing, turning and fitting, printing, house-painting, sign-writing. There are in all fifty-eight different subjects, taught by a staff of forty-seven instructors and assistants, of whom six are fully employed at the College, the rest rendering occasional services, mostly during the evening.

The College is governed by a council, of which Professor W. C. Kernot, M.A., of the Melbourne University, is president. The council is composed of sixteen members, representing the founder, the Government, the University, the Public Library, the Trades' Hall Council, and the subscribers.

THE NATIONAL EDUCATION ASSOCIATION.

THE annual meeting of this association passed resolutions condemning the action of the Education Department in reversing their settled policy of the past twenty years in reference to higher-grade schools, and thus attempting to restrict the natural growth of popular education. It also protested against the assumption that local authorities for secondary education already exist, since the organisations named in Clause VII. of the Science and Art Directory are not statutory, and therefore not entitled to parliamentary recognition.

The meeting also unanimously adopted a resolution declaring that legislation which did not provide for the equal eligibility of women and men to sit on the local authorities for secondary education would be unsatisfactory.

The present policy of the Department is to make it impossible to carry on any instruction, either of class or school, in science or art beyond what is contained in the day or evening school code unless fees are charged or subscriptions obtained. This is clearly set forth in a letter which came before the London School Board on the fifteenth of February. In it the Department says:—

"(XII.) That, in certain science or art schools and classes under the management of School Boards, no fees are charged, and the cost of the instruction given is defrayed out of the school fund; that they are advised that this application of the school fund is illegal; that as, however, the question of the legality of this application of the school fund is at present the subject of an appeal to the High Court, they will take no initiative to disturb, by withdrawal of their grant, the teaching, in such schools and classes, of those subjects of science and art which have been heretofore taught; that it must not be understood from this that the maintenance of a science or art school or class by a School Board out of the school fund is legal; that they will refuse to recognise new schools or new classes, or new subjects in existing schools or classes, if they are supported wholly or partially out of the school fund; that in Section VI., page 2, of the Science and Art Directory, it is provided that every science or art school or class must have local support, either in the form of fees and subscriptions or of rates; that no school or class will be permitted to charge abnormally low fees in order to compete with others in the same locality; and that, in this section, the word 'rates' applies to rates levied under the Technical Instruction Acts, or any other rates which may be lawfully applied to the payment of science and art instruction, and not to the 'school fund,' which is raised under the provisions of the Elementary Education Acts, and cannot, as the Department are advised, be lawfully so applied: and inquiring, as it appears from the Forms 120 for the twenty-six schools named in an attached list, that no fee is charged for instruction in the subjects indicated, and as these subjects were not taught in the respective schools last session, how the Board propose to comply with the rules stated in this letter."

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OUR CLASS-ROOM AIDS.

NOTES OF TWO LESSONS ON THE MOON.

By WILLIAM DONE, B.A., *Head-Master of Brighton Pupil Teachers' School.*

(Circular 369—III. The Moon—Changes of Shape, etc.)

Articles of Illustration.—Some cardboard discs representing the comparative sizes of the earth and moon; a common lamp, and a large ball capable of being covered with paint or chalk; diagrams illustrating the phases of the moon and tides.

LESSON I.

HEADS.	MATTER AND METHOD.
I. What gives the Moon its bright appearance.	Cause the light from a lamp, or from the gas, to fall upon a mirror or other suitable object. Both things look bright, or shine; but one is a source of light, the other only reflects the light. Apply our illustration to the sun and moon. The light we receive from the moon is reflected sunlight. (The phenomenon known as earth-shine is, of course, not mentioned.)
II. The size of the Moon as compared with the sizes of the Earth and Sun.	Some questioning will elicit that the moon in the heavens appears nearly the same size as the sun. A fairly good idea may be given of the comparative sizes of the moon, earth, and sun by noting that the diameters of these bodies are, roughly, in the ratios of 1 : 4 : 400.
III. Why the Moon's face appears almost as large as that of the Sun.	Recall the fact that objects look smaller the greater the distance they are from the person viewing them, and so let the class infer that the moon must be very considerably nearer to the earth than the sun is. Thus, while the moon's average distance from us is about 238,000 miles, the sun is 93,000,000 miles away—which also works out in the ratio of about 1 to 400.
IV. Why the Moon's face appears larger when she is nearer the horizon than when she is higher in the heavens.	Perhaps some of the children would have noticed that the illuminated face of the moon, when low down in the sky, appears larger than when high up in the heavens. Draw a diagram showing that the light from the moon has to pass through a much greater extent of atmosphere in the one case than in the other. Illustrate by likening the atmosphere to a lens: the thicker the lens, the greater its magnifying power.
V. The changes in the Moon's face.	For some time previously to the lesson the children should have been asked to notice the change in the shape of the moon, and also to draw the shape on pieces of paper, which drawings should have been handed in to the teacher before the lesson commenced. From the diagram on the blackboard of the phases of the moon, individual children would recognise the several appearances as they drew them. The phases may now be further illustrated by means of a lamp, a ball, and the globe. The names *new moon* and *full moon* are probably already familiar to the class. The additional terms of *first quarter* and *last quarter* may be given. From the fact that the teacher had to carry the ball round the globe in order to get the necessary illuminated appearances, the children will infer that the actual moon travels round the earth. From the accounts they have kept of the interval between full moon and first quarter, etc., they will be able to state that the whole of the moon's journey is performed in a period of just about four weeks. The name *moon*, meaning "a measurer of time," might be given.

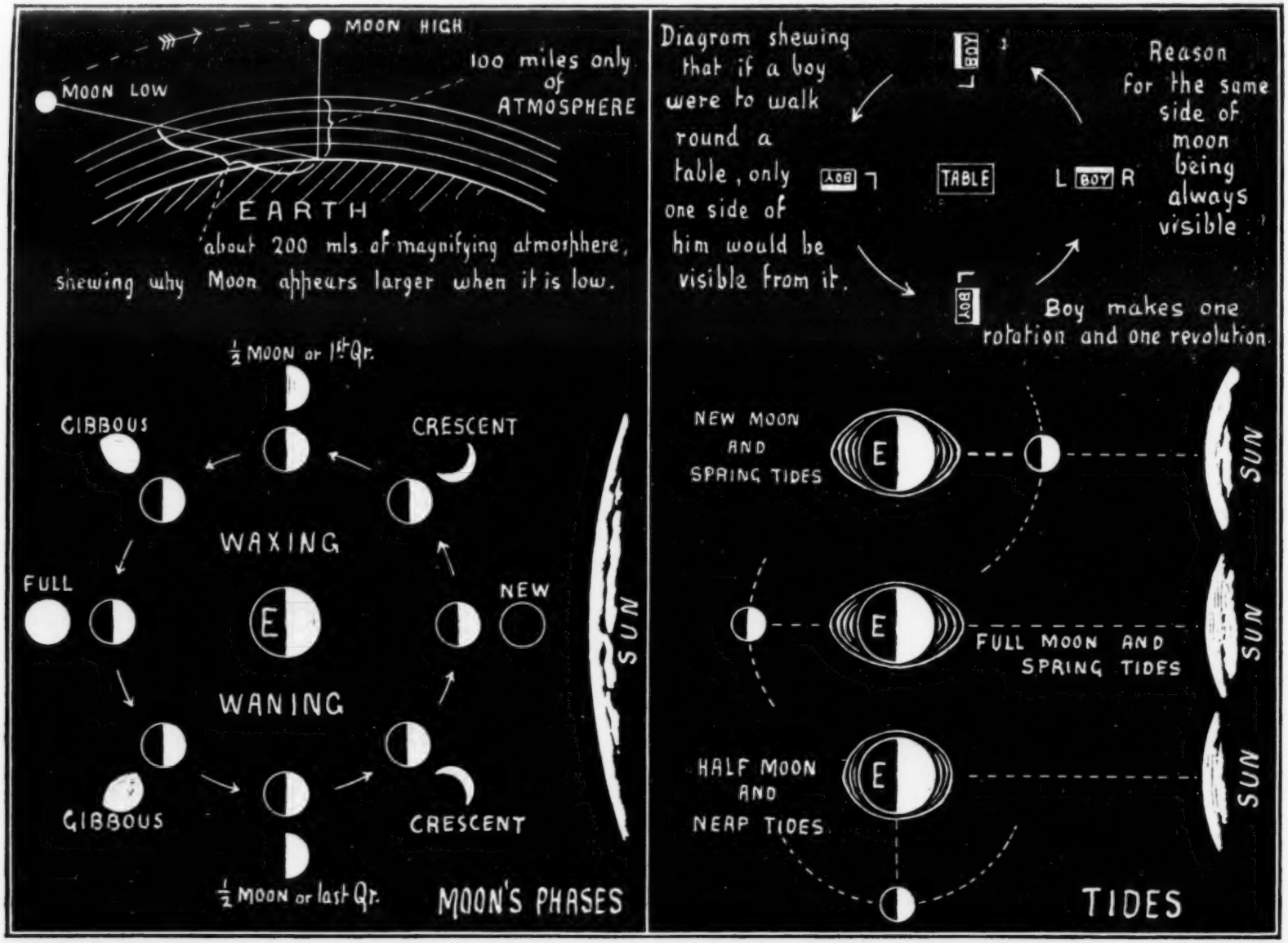
LESSON II.

HEADS.	MATTER AND METHOD.
I. Why we see only one side of the Moon.	Let a child come to the front of the class and walk round the table, always keeping his face turned towards the table. After careful observation, it may be inferred that the child has been performing two movements: he has made a complete revolution round the table, and also a complete rotation. Refer to the fact that at full moon we always see the same markings on the moon's face. Evidently, then, the moon's revolution and rotation take just the same interval of time.
II. Tides.	Refer to the daily ebb and flow of the waters of the sea, and the terms *low water* and *high water*. Question out that high water occurs twice daily, and low water in a similar manner. If living near the seaside, the children will know that the interval between two high tides or two low tides is not exactly twelve hours, but practically twelve and a half hours. They will know also that there occur tides called *spring tides*, when high water is higher and low water recedes farther than at the time of *neap tides*. The class is now in a position to profit by the diagram on the tides. Tides are caused by the attraction of the waters of the ocean by the sun and moon. Take the case of lunar attraction first. The moon attracts the whole mass of the earth, but the water directly opposite the moon becomes heaped up, because water has a smaller cohesive power than solid land. But the greater cohesive power of the land will cause it, as it were, to become drawn away from the water on the other side of the globe; so that two high tides, and hence two low tides, occur simultaneously. If, therefore, the moon were stationary, while the earth rotated, we should have high tide and low tide every twelve hours. But as the moon and the earth are not at rest, this exact interval of time does not hold, and, as we noted above, the time is about twelve and a half hours. From the diagram we see that the sun and moon may be in a straight line with the earth, or the line joining the three bodies may form a right angle. In the former case the tide-producing power will be greater than in the latter case. The great tides produced in the former case are called *spring tides*, the others *neap tides*. The children may be told that the moon has a greater effect in producing tides than the sun. The reason would be too intricate for them to follow.

BLACKBOARD ILLUSTRATION.

BLACKBOARD ILLUSTRATION.

BY C. ARMSTRONG, EXAMINER TO DEPARTMENT OF SCIENCE AND ART.



PRACTICAL ELEMENTARY SCIENCE.

AN EXPERIMENTAL COURSE COVERING THE REQUIREMENTS OF BOTH THE DAY AND EVENING SCHOOL CODES IN PHYSICS AND CHEMISTRY.

BY THOMAS CARTWRIGHT, B.A., B.SC.,

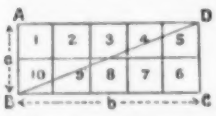
Author of "Practical Chemistry," "'Section One' Physiography," etc.

Area and Volume.—The interesting exercises that can be set under this head are exceedingly numerous and profitable, and the apparatus required is of the simplest and least expensive character; hence the teacher will do well to pay particular attention to this branch of practical science.

Area.—To most children this term is absolutely meaningless, and the same may be said of surface size. When, however, a child is got to regard area as covering-power, as in the case of carpets and wall-paper, he has something in his mind that he understands, at least in part, and may be made to see that length alone does not convey what is meant by area. In this way space in two dimensions may be realised, although it may still be difficult to get a clear expression of what is understood. Questions as to the size of a window, a floor, a wall, etc., will lead most naturally to a consideration of the subject.

Square Measure.—The square is the best measure of surface size, because of the identity between length and breadth, and because of the familiarity of the child with this particular form; and a useful preliminary exercise is to cut out a square foot in paper, and to see how many times this will go into a certain space. Let the children cut out in paper—(1) square inch; (2) square foot; (3) square yard; (4) square centimetre; (5) square decimetre; (6) square metre.

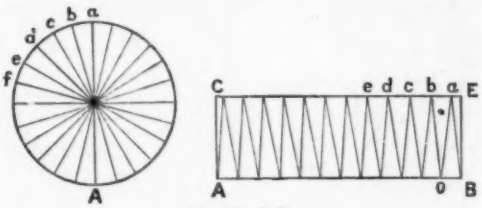
Area = Length × Breadth.—To make this clear, take a line, say, three inches long, and make a rectangle whose other side is one inch. We have now one tier of squares, making in all three squares. If now we make the height, two inches, we have another tier of three, and so on; so that the height tells the number of tiers, whilst the length of the base tells the number of squares in each tier: hence the rule for obtaining the area of a rectangle, of which a square is only a particular case. That the area of a triangle is base × half height will be readily seen in that particular case where the triangle is made by the bisection of a rectangle, and but little trouble will be found in extending the rule to parallelograms that are not rectangular, and to triangles that are the halves of such parallelograms.



Area of a rectangle and triangle.

Of course, if the geometrical knowledge of the pupils is sufficiently advanced, reference should here be made to the equality of parallelograms upon the same or equal bases, and between the same parallels. Indeed, I have always found that the perception of this truth by students ignorant of Euclid is not only immediate, but is also a source of curious interest to them. Hence it is wise to at least refer to this geometrical truth with respect to both parallelograms and triangles when dealing with the rule for finding their areas.

The Circle.—To find the area of a circle is an exceedingly popular exercise. A circle of a given radius is drawn as in the figure, and is divided into any number of small equal triangles by means of intersecting diameters. A rectangle is drawn whose sides are the length of half the circumference, and of the radius of this circle respectively. The small triangles are carefully cut out of the circle, and are fitted into the rectangle, which is thus proved to be equal in area to the circle; therefore the area of the circle equals the product of the radius into half the circumference. But we have already found that the circumference of a circle = 3⅐ times the diameter, and so the half-circumference = 3⅐ times the radius; hence the rule for finding the area of a circle is, Multiply the radius by 3⅐ times the radius, or 3⅐ × the square of the radius—all of which the pupil should be expected to find out for himself.

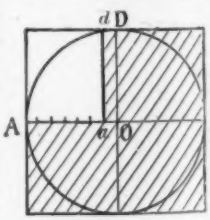


Area of a circle.

Area of the Surface of a Sphere.—The experimental determination of the area of a sphere is not easy to accurately perform, but the result is so interesting in comparison with both a circle of the same radius and a cylinder of the same diameter and height, that the exercise should on no account be omitted. Perhaps the best method is to use a tennis-ball, the flannel covering of which readily lends itself to flattening out. Measure the diameter of the ball, strip off the covering, and measure its area on squared paper. Now get a piece of paper and circumscribe the sphere therewith, taking care to have the paper just as high as the sphere. Find the area of this rectangular piece of paper, and compare with the area just obtained. The two results should coincide. Next calculate the area of the circle having the same diameter as the sphere by using the formula πr^2, or, if preferred, find the area of the circle by drawing it on squared paper. It will come as a very pleasant revelation to the boys that the area of a sphere is just the same as that of the curved surface of the circumscribing cylinder, and is just four times the area of the circle having the same diameter—that is, area of sphere = $4\pi r^2$.

Area by Cardboard Weighing.—The desire to prove that the area of a circle really does = 3⅐ × rad² leads naturally up to this interesting branch of the work. At the outset it should be impressed upon the children that the cardboard is of the *same thickness throughout*, and therefore equal areas of it will also be equal in weight, no matter what the shape of these areas may be. This should be proved by cutting out a square, say, of four-inch sides, and a rectangle two inches by eight inches. By placing them upon opposite pans of the balance, their equality in weight may readily be demonstrated; and by cutting the rectangle in two, and by superimposing the two halves upon the square, equality in area may be just as readily shown.

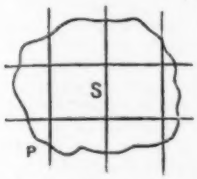
Two circles of the same radius—say four inches—are now to be drawn on the cardboard, and about one is placed a square divided into four equal squares, as in the figure, the line O*a* being made exactly one-seventh of OA, so that O*ad*D is equal in area to one-seventh of one of these four squares, each of which, it should be carefully noted, is the square of the radius of the circle in question, and therefore the shaded area is equal to 3⅐ the square of the radius. To prove that this is equal to the area of the circle, all that is needed is to cut out the circle that was first drawn, and also to cut out the shaded area in the square drawn around the second circle, and to place the two areas upon opposite pans of the balance, when they will be found to be equal in weight, and therefore equal in area. This exercise should be performed by every individual scholar, not necessarily all at the same time, but as convenience permits. The meaning of π may or may not be explained, according as the fancy of the teacher dictates; but if such explanation is given, then the brief πr^2 may be substituted for the more cumbersome 3⅐ × rad² as the expression of the area of a circle.



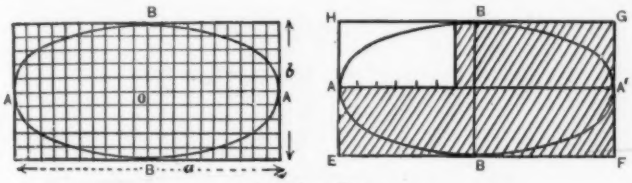
Area of circle.

The use of squared paper in getting the areas of irregular surfaces may conveniently follow on here; indeed, it should be urged as a further proof of the correctness of the above formula.

Further Exercises.—A very useful continuation of measurement of area is afforded by the surfaces of solids. Paper may be spread over these surfaces so as to exactly cover them, and the area of the paper may afterwards be obtained by the methods already explained. In this way it may easily be proved that the area of the curved surface of a cylinder is expressed by $2\pi rl$, and that the area of the curved surface of a cone is half the circumference of the base multiplied by the slant side. Again, it will be interesting to show that the area of an ellipse equals $\frac{\pi}{4}$ times the product of the major and minor axes. This should be proved by means of squared paper and by cardboard weighing. The accompanying diagrams will make clear how this may be done.



Area of an irregular figure.

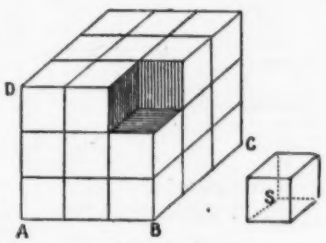


Area of an ellipse.

A very popular exercise is to prove Euclid I. 47 by cutting out the squares in cardboard and weighing.

The formation of square measure (both English and metric) from linear measure by squaring the latter should be continually impressed upon the pupils in connection with the above experiments, which are calculated to make the pupils clearly perceive not only the difference but also the connection between linear and square measures—a point deserving very special attention, since the ideas of scholars in this connection are, as a rule, woefully vague. The number of square centimetres in a square inch should be ascertained by cutting out one square inch and one square centimetre, and by placing the latter on the former.

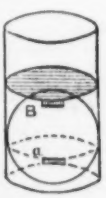
Volume.—Each pupil should come provided with a cube of wood, such as the well-known toy letter blocks. The first step should be to record how many edges and how many faces the block possesses; and it will be well to link the new lesson to the old by measuring the length of the edges and the area of the faces. In the second place, it should be asked how the size of the block, and also of other solids, may be expressed, the aim being to show that three dimensions—namely, length, breadth, and depth—must be taken into consideration before an adequate idea of the size of a solid can be arrived at. It may be pointed out that the simplest kind of solid is one in which these three dimensions are identical, such as the cube; hence the propriety of using a cube as the unit or standard, hence also the fitness of the term *cubic* to this kind of measurement. A cross, with all its sides an inch long, should be cut out of cardboard paper. The edges should be bent up to form a box, and should be carefully gummed together by means of gummed paper. The outside of the box may usefully be dipped in molten paraffin wax, so that later on the box may be utilised in obtaining the weight of a cubic inch of water. The children should be led to describe this box as a cubic inch, after which another way of expressing how big the box is should be asked for. If the right answer is not forthcoming, a hint may be given by asking why the outside was covered with paraffin. The answer to be got is, of course, that the size of the vessel may be expressed by saying how much water it will hold; and the fact that *holding power* is another way of expressing size in three dimensions should be well brought home to the children, who should firmly associate in their minds the two terms *volume* and *capacity*. Following next in order should come the inculcation of the rule that volume, in the case of rectangular solids, is the product of length, breadth, and depth; and a child's box of cubical bricks will be found most useful here. If one layer, consisting of four rows of four cubes each, is placed on the ground, it will be easy to get the pupils to see that the volume of the solid thus formed is sixteen times as great as that of one cube, whatever the edge of the cube may be. Another layer should be placed upon this first layer, when the volume becomes thirty-two times as great, and so on. It should now be shown that the same result would have been arrived at by simply multiplying together the length, the breadth, and the depth or thickness. If cubes of an inch edge can be got, the experiment will be all the more successful; and the pupil can easily be brought to see the connection between linear, square, and cubic measurements by calculating how many of these cubes will be required to form a cubic foot—the identity of this calculation with the product of $12 \times 12 \times 12$ being, of course, especially insisted upon. It will be wise to spend a considerable amount of time in making sure that the pupils have very clear ideas as to the meaning of cubical content; for if children's ideas are vague as to the expression of area, they are infinitely more so as to the calculation and expression of volume.



Volume of a cube.

It will now be necessary to study the various kinds of measuring vessels, such as the measuring cylinder, the burette, and the pipette. All that need be said here is that the pupils should handle the vessels themselves, and verify by experiment all that is told them about these vessels. The teacher will get all the information he needs by referring to any work on elementary practical physics, such as that written by Mr. Castle, and published by Messrs. Nelson and Sons. In reading the heights of liquids, the disturbing effect of the meniscus must be referred to, which may be best done by drawing attention to capillarity as exemplified in wicks and by narrow tubes.

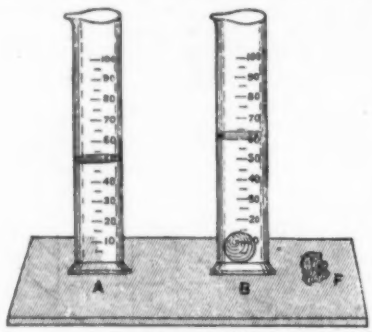
Volume of a Sphere.—A sphere of wood or of metal is placed in a tumbler or beaker, and water is run into the beaker until it just covers the top of the sphere, which must obviously not be allowed to float. If a wooden sphere is employed, it must be held down by means of a shawl-pin or some other device. The sphere should be oiled, in order that water may not adhere to it. A strip of gummed paper should be put on the beaker to fix the height to which the water rose. The sphere should now be removed from the beaker, and more water should be run in until the level is again up to the paper. The volume of water run in is equal to the volume of the sphere. It will be noted by the teacher who has but one measuring vessel that the pupils can readily supply themselves with all the apparatus really necessary to the performance of this and kindred determinations as class experiments. A couple of tumblers and a wooden or, better still, a stone ball is all that the pupil needs. The ball having been placed in one tumbler, water is poured in from the other, and the level marked as before.



Volume of a sphere.

The amount of water needed to restore this level can easily be fixed by putting gummed paper to mark the level to which the water sinks upon the withdrawal of the ball, and this amount of water can be run into the measuring cylinder or burette at leisure. Of course it will be better to have a liberal supply of measuring vessels, but it is not necessary to forego the experiment because this desirable supply is not

forthcoming. The volume of any solid, regular or irregular, can be obtained by means of this simple device, a variation of which can be employed by using the measuring cylinder directly as follows:—Water is placed in the cylinder, and the height is very carefully noted. A pebble or other solid is made to sink in the water until completely immersed, when the increase in level will indicate the volume of the immersed solid. It will be useful to show the connection between the volume of the sphere obtained as above, and its diameter as obtained by blocks in the exercise in linear measurement. The formula $\frac{4}{3}\pi r^3$ need not, of course, be put in its algebraical form, but may be expressed verbally. The same experiment will give the volume of a cylinder, which should be shown



Volume of a solid.

to equal area of base × height ($\pi r^2 h$); and much interest should be aroused in showing that the volume of a sphere equals two-thirds of the volume of the circumscribing cylinder—that is, a cylinder having a height equal to the diameter of the sphere, and a base the radius of which equals the radius of the sphere.

This can be shown by taking a sphere that exactly equals in diameter the beaker that is to be employed in the experiment. The volume of the sphere having been determined as in the preceding experiment, it is placed in the beaker, and is just covered with water. The amount of water needed to cover it is now ascertained, and the ratio between this and the volume of the sphere will prove the truth of the statement made above—namely, that the volume of a sphere is two-thirds that of the volume of the circumscribing cylinder.

The volume of a cone and of a pyramid are equally interesting in their experimental determination, but the above experiments will probably be found to exhaust all the time that may be conveniently given to this branch of the subject; hence we leave it, pointing out that the subject is just as wide as it is interesting.

A NEW AND SIMPLE METHOD OF PROVING QUESTIONS IN ARITHMETIC.

FOR TEACHERS AND STUDENTS.

Number-Casting with Nine.

THE number nine has, as well as eleven, a peculiar property which renders it unnecessary to employ direct division in order to find a remainder. For this reason nine-casting is explained in some works on arithmetic, but its application is shown only as far as the four simple rules. It may be applied just as well to all the examples we have given for the use of 11. We shall now show its special method of application.

A Property of the Number Nine.

Any number is divisible by 9 if the sum of the digits composing the number is also divisible by 9. Take as examples of this some multiples of 9—for example, 18, 36, 72, 108, 180, 3465, 849321. The figures of each of the first five examples, added together—8 + 1, 3 + 6, 7 + 2, 1 + 0 + 8, 1 + 8 + 0—make up 9 exactly; the sum of the figures of 3465 equals 18, and of 849321 equals 27.

Further, the remainder left, after dividing the *sum* of the digits of any number by 9, is the same as the remainder left when the number itself is divided by 9. For instance, divide 10 + 5 by 9 and the remainder is 6, the same remainder as would be left after dividing 15 or 51 (numbers composed of 1 and 5) by 9. Any number, large or small, may be tried in the same way. For example, 2873 and 2 + 8 + 7 + 3, each divided by 9, have for a remainder 2; or 75308 and 7 + 5 + 3 + 0 + 8, treated in the same way, give a remainder of 5 in each case.

Simple Addition.

The above property of the number nine is made use of in nine-casting to prove the correctness of calculations. We shall, as formerly, give some examples to show the method of application, beginning with simple addition.

Example:—

82734
16365
54919
46871
58206
14735
273830

Since it is of importance to note only the remainders after dividing by 9, the work may be much simplified, as was shown in the case of eleven, by discarding or casting out, as we go along, any *nines*, figures of which the *sum* is nine, or *multiples* of 9. The above example has been framed so as to show how the remainder may frequently be found with little more than a glance at the figures.

If the figures of the two top rows are looked over at the same time, it can be seen almost at once that there is no remainder from them, since the figures are 8 and 1, 6 and 3, 2 and 7, etc. In the next two rows we cast out at once 9, 9, 7, 1, 1, 4, 5, which combine to form nines. There are then left 8, 6, and 4; but these may also be rejected, as their sum is 18, a multiple of 9. In the same way, the figures of the last two rows, 5, 4, 8, 1, etc., combine to form nines, except in the case of 0 and 5. The remainder, therefore, after nine-casting is **5**; and it will be found that, after performing a like operation in the answer, the remainder is also **5**. In casting out the nines, the figures may, when being added, be taken in *any* order, either up and down or across.

Simple Multiplication.

Example:—

2785
498
22280
25065
11140
1386930

Applying the test of nine-casting to the example, the nines are first cast out of the multiplicand by adding the figures 8 and 5, which make 13; and 13 gives a N.C. rem. of 4. It should be noticed that the 7 and 2 are not taken into account, since their sum is 9. From the multiplier we obtain a N.C. rem. of 3. These N.C. remainders, 4 and 3, are multiplied together and nine cast out of their product (12), which leaves a final N.C. rem. of **3**. A glance over the figures, 1386930, of the product of the two numbers shows that, after nine-casting, it also yields a N.C. rem. of **3**, which corresponds with the other.

Simple Division.

The rules given for testing questions in division by eleven-casting apply equally to nine-casting, except that where a figure has to be *borrowed*, it is 9 instead of 11 that has to be used. The remarks made as to questions where the factor 11 occurs must also be observed with the factor 9, which should be removed in nine-casting in the same way, in order to make a full test of correctness.

Reduction.

£43, 17s. 11d., reduced to pence, is equal to 10535 pence.

First cast out the nines from £43, 17s. 11d. The N.C. rem. from 43 is 7 (4 + 3); 7 has to be multiplied by 20, but by nine-casting with 20, it is the same if 7 be multiplied by 2, and the remainder then from 14 + 17 (or 1, 4, 1, 7) is 4—that is, 4 shillings. Instead of multiplying 4 by 12, we multiply it by 3 (the N.C. rem. from 12); 4 × 3 = 12, and the N.C. rem. from 12 + 11 (or 3 + 2) is, of course, 5.

The same remainder 5 is obtained also from 10535 pence.

We may here remark that when 5½ yds. is used as a multiplier, it is first treated by nine-casting, and its N.C. rem. used as the multiplier instead. This N.C. rem. is 1, for 5½ is equal to 5·5. In the same way, the N.C. rem. from 30¼ sq. yds. (or 30·25) is also 1; and from 2¼ inches (1 nail in cloth measure), or 2·25, it is 0. These three results should be kept in mind. In other quantities the N.C. rems. are easily found—such as, 2 for 20 shillings, or for 20 cwt.; 1 for 28 lbs.; 4 for 40 poles; 3 for 12 inches, or for 12 pence; and so on.

Compound Addition.

Example:—

£37	18	8½
152	15	10¾
6	3	1¼
0	17	9
£197	15	5½

Take first the addition of the pounds. Casting out the nines from the addition of 37, 152, and 6, we have a N.C. rem. of 6—that is, £6, which equals 120 shillings. Treat the shillings in the same way, including 120. Remembering that we have only, in nine-casting, to add the separate figures, we have 1 + 2 (from 120) + 1 + 8 + 1 + 5 + 3, etc. From the shillings we get a N.C. rem. of 2. This being multiplied either by 12 or 3, we carry the N.C. rem., which is 6, to the pence; and from the pence we obtain the N.C. rem. of 7. Proceeding in the same way, we get from the farthings a final N.C. rem. of 7.

Take now the sum and proceed with nine-casting in the same manner. £197 gives a N.C. rem. of 8. £8 = 160 shillings; and from 160 + 15 (1, 6, 1, 5) we get a N.C. rem. of 4 shillings. Continuing, we have a final N.C. rem. from the farthings of 7 also.

Compound Multiplication.

Example:—

17 cwt. 3 qrs. 9 lbs. 4 oz., multiplied by 83, is equal to 74 tons 0 cwt. 0 qr. 11 lbs. 12 oz.

If 17 cwt. 3 qrs., etc., be divided by 9 by the methods for nine-casting already shown, the remainder obtained is 6, and from 83 is 2. Multiply 6 by 2, which equals 12, and the remainder after nine-casting is 3.

From 74 tons 0 cwt. 0 qr., etc., the remainder of 3 is also found.

Advantages of Eleven-Casting.

Two things are required of any method of proof in order that it may be really useful. These are—(1) that it be simple and can be applied quickly, and (2) that it be reliable. We do not hesitate to affirm that eleven-casting fulfils both of these conditions in the case of any calculation to which it is applied, and these cases have been shown to be very many. It must be admitted that the method is simple; and after a little practice, the process is carried on almost mechanically.

It may perhaps be necessary to examine more particularly its claims to be a reliable test. We have referred to objections to the use of the number nine. Those usually urged against it are that nine-casting will not show an error in the following cases:—

If a 0 has been substituted for a 9, or a 9 for a 0.

If one or more ciphers or nines have been omitted.

If the figures have been misplaced.

The above objections are of sufficient force to prevent nine-casting from becoming of general and practical use. None of these objections, however, can be urged against eleven-casting. We have throughout shown wherein any weakness might lie in the method, and at the same time it has been shown how such might be *entirely* overcome. This weakness lies in questions where the number eleven itself occurs, chiefly as a factor of the numbers in question, or where its omission would cause no difference in the N.C. remainders. In this itself, however, there need be no unreliability, if a little extra care and attention be bestowed on such cases.

Further, we believe that eleven-casting will bear comparison with the methods usually employed at present to prove the correctness of calculations. There is no doubt that that which is regarded as the greatest test of all is to take the answer and show, by using it, that the data of the question correspond with it exactly; but this usually entails nearly as much work as the original working of the question. Another test is to work out the question, where this can be done, by a different form, which also entails much work, but is reliable. The proof usually employed is, we suppose, to go over the work as originally carried out; but this is by no means reliable, for it is well known that one is very apt to repeat or overlook an error which one has already made.

Eleven-casting possesses the great advantage that the proof of the calculation is usually made by a process entirely different from the working of the question itself, and is chiefly concerned with the data and the result alone.

Considering, then, its simplicity, quickness of application, and reliability, it must be allowed that it will be of very great advantage to all who have calculations to make.

ELEMENTARY LESSONS IN THE PRINCIPLES OF GRAMMAR.

A Course of Forty Oral Lessons for the First Year (New Code, Standard IV.).

BY JOHN R. TIMSON, B.A.

Head-Master, Board Schools, Royston, Barnsley.

LESSON XXIII.

INTERROGATIVE WORDS.

If we desire to know any quality of a thing, we use "what" before the general name of the quality required; for example,—

What colour is the horse?
The horse is *black*.
What shape is the world?
The world is *round*.

The word "what" is here an *Interrogative Adjective*.

In asking a hearer to distinguish or separate a thing from other things, we use "which"—

Which boy was it?
It was *this* boy.

"Which" is here an *Interrogative Adjective*.

To inquire the time, place, manner, or cause of an action we use *Interrogative Adverbs* as, "when," "where," "how;" for example,—

When is he going?
He is going *to-morrow*.

We may also use prepositions with the interrogative adjectives "what" or "which." Remember, "what" and "which," to be adjectives, must be followed by a noun—

At *what* time will he come?
To *which* place does he go?

Perhaps the most important point in asking questions is the indication of the word to be answered by saying it more loudly and more distinctly than the other words. The word has thus "emphasis" or "stress" put on it by the speaker; for example,—

Did you ride into the town to-day?
No, I *did* not.
Did *you* ride into the town to-day?
No, not *I*; but John did.
Did you *ride* into the town to-day?
No, I *walked*.
Did you ride *into* the town to-day?
No, I rode *out* of it.

Any particular word emphasised in the question thus indicates what the speaker desires to know.

We will now collect the various ways we have mentioned of asking questions:—

1. In the present and past tenses of the verbs "to be," "to have," "will," "shall," "can," "may," "must," and "ought," by putting the verb before the subject.
2. By using "do" and "did."
3. By placing the auxiliary verb first in the question.
4. By the interrogative pronouns "who," "whom," "whose," and "which."
5. By the interrogative adjectives "what" and "which" used with nouns.
6. By interrogative adverbs—"how," "when," and "where."
7. By prepositions with "what."
8. By emphasis, denoting the particular word which is to be answered.

MEMORY NOTES.

The auxiliary verbs of interrogation are "do" and "did."

The interrogative pronouns are "who," "whom," "whose," "what," and "which."

The interrogative adjectives are "what" and "which."

The interrogative adverbs are "where," "when," "how," "why," "whither," etc.

LESSON XXIV.

RELATION.

Those people who are most nearly connected with us by birth are called our relatives. Parents, children, brothers, and sisters are related together.

Any connection of things may be called a relation. All things are connected in time and place, and any one thing may be said to be related to everything else. This boy is Tom, and everything besides may be called "not-Tom."

A quality is related to a thing, and an adjective is related to a noun. Words relate to things. The connection of an adjective with a noun relates to the connection of a quality with a thing.

Let us resolve never to use a word unless we have its meaning clear in our thoughts. The word "relation" may mean any kind of connection, so that before we use it we must know in what the connection consists.

A question requires an answer. The answer relates to the question. Every interrogative word is related to the word which answers it.

Who spilt the ink?
Tom spilt the ink.

The words "who" and "Tom" are related or connected together by question and answer. They both mean the same person, but we do not know the meaning of "who" until the name "Tom" informs us. "Who" asks for the name "Tom," to indicate the person meant. This is the only connection for which the word "relation" need be used in grammar. If one word has its meaning supplied by another word, then the one word is said to *relate* to the other word.

It was Tom *who* spilt the ink.

"Who" relates to "Tom." The word "who" seems to say to a hearer, "Go to the word Tom just said, and you will discover the person I mean." For this reason "who" is called a Relative Pronoun. A relative pronoun refers to another word for its meaning. The relative pronouns are—

"Who," "whom," "whose," for persons.
"Which," for other things.
"That," for persons and things.

When the word "that" is a relative pronoun, it may be changed into "who," "whom," or "which."

The boy ran away.
The boy stole the apples.

We may join these two statements together and say,—

The boy *who* stole the apples ran away.

"Who" joins the two sentences, and also stands for the word "boy" going before it. The relative pronoun refers to a name going before it. The name that goes before is called the Antecedent. *Ante* means "before," *cedent* means "going."

We have noticed how things give rise to classes of words and their divisions. Nouns and pronouns thus obtain gender, number, and person. If a thing remains the same but has many names, these names will all be of the same gender, number, and person.

The *man who* saw the deed was afraid.

"Man" and "who" mean the same person. It is the man himself who by being one of the male sex, and neither speaker nor hearer, causes the name "man" to be masculine gender, singular number, and third person. The word "who" must be the same in these points. Hence we have the rule—

"Every pronoun agrees with its antecedent in gender, number, and person."

Who...Relative pronoun, masculine gender, singular number, third person, nominative case to "saw."

It is not so with case. Case is the use of a name by a speaker in making an assertion. The speaker may make the same thing to be the subject of one assertion and the object of another. The relative pronoun does not necessarily agree with the antecedent in case, which must be found from the verb or from a preposition.

The man whipped the *boy who* stole the apples.

Boy....Objective case, governed by "whipped."
Who...Nominative case to "stole."

The *boy whom* the man whipped stole the apples.

Boy .....Nominative case to "stole."
Whom...Objective case, governed by "whipped."

It is very important to know when to use "who" and "whom," and great care should be taken to prevent mistakes.

"Who" is always nominative case, "whom" objective case, and "whose" possessive case.

Never use "which" for persons. "That" is used for "who," "whom," and "which."

MEMORY NOTES.

A relative pronoun is a word which refers to a noun or pronoun going before it. It also joins sentences.

The relative pronouns are "who," "whose," "whom," "which," and "that."

A pronoun agrees with its antecedent in gender, number, and person. Never use "which" for persons.

(*To be continued.*)

THE INSPECTOR'S NOTEBOOK.

BY AN INSPECTOR OF SCHOOLS.

THE CLASS SUBJECTS: HISTORY.

Geography and English displace History. PERSONALLY, I do not look with favour upon the teaching of history in the lower standards; and even in the upper standards I should not displace either geography or English for it. Nevertheless it is highly essential for all children to know just a little about the past. This can be done through the reading lesson. Obtain a first-class set of history reading books.

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Some History Teaching is necessary. Geography and history should, wherever possible, be taught together. History is not largely taught in schools. From the latest returns it appears that 5,780 departments took history, and 17,049 took geography, as a class subject. History, more than any subject almost, is liable to be taught mechanically. In many cases only masses of facts are dealt with. It needs an excellent teacher to supply vivid teaching in a subject so devoid of the concrete. Morality, patriotism, and many other of the best qualities of a nation can best be inculcated through good history lessons. Always, therefore, I should devote one lesson a week to this subject in the upper standards of schools not taking it as a class subject.

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History taken throughout the School. And now, to come to those schools taking history as a class subject, let us consider first the time to be given to it. In Standards I., II., and III., I should say, three lessons of half an hour each would be ample. In the upper standards I should make the lessons slightly longer, and give two and a half hours to the subject.

In the first two standards you will probably keep to the course indicated in the reading-book you use. The Code allows you perfect freedom in the selection of the twelve stories. You will therefore choose them from any part of the history. The idea with the young children is to interest them by stories in the great events and the great men. It is therefore useful not to adhere to one period. In the small schools scheme reference is made to illustrations. There are plenty of good pictures now published, and you should, as far as possible, use such in your lessons to the youngest children. The following stories are thought typical of the lower standard requirements:—Introduction of Christianity, the Norman Conquest, the Discovery of America, the Spanish Armada, the Great Rebellion, Wolfe at Quebec, the Battle of Trafalgar.

For the guidance of rural schools chiefly, I submit an alternative list to the above:—

1. King Alfred the Great.
2. William the Norman.
3. The White Ship.
4. Caxton.
5. Thomas Wolsey.
6. Oak Apple Day.
7. Gunpowder Plot.
8. Trafalgar.
9. Waterloo.
10. George Stephenson.
11. Queen Victoria.
12. The Diamond Jubilee.

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Standards III. and IV. Courses. We now come to the Standard III. course, which is to comprise twelve stories or simple biographies from British history down to 1485. It would be advisable to take a large portion of the course from the time subsequent to the Conquest. This latter part might be almost treated as a connected narrative under the various kings, dealing, of course, only with the main outlines.

In Standard IV. twenty stories are to be prepared, from 1485 to 1688. The following are suitable:—The First Printing Press, the Discovery of America, Cardinal Wolsey, Henry the Eighth, Elizabeth, the Spanish Armada, Drake, Raleigh, Shakespeare, the Pilgrim Fathers, Charles the First, Cromwell, Monk, James the Second.

But as most schools taking history usually commence it in Standard IV., it will be well to give a list for such. The course for these schools comprises twenty stories and biographies down to 1603. Here is a scheme:—

1. The Coming of Cæsar.
2. The Coming of the English.
3. Alfred.
4. The Danish Kings.
5. William the Conqueror.
6. Richard Cœur de Lion.
7. Magna Charta.
8. Edward the First.
9. Bruce of Scotland.
10. Henry the Fifth.
11. Joan of Arc.
12 and 13. The Wars of the Roses.
14. Columbus.
15. Cardinal Wolsey.
16. Queen Mary.
17. Queen Elizabeth.
18. The Great Seamen.
19. The Armada.
20. James the First.

* * * * * *

Courses for the Upper Standards. Standard V. ordinarily take the Tudor period, special attention being paid to the biographies of the leading persons—for example, the Protector Somerset, Queen Elizabeth, Shakespeare, Raleigh, Cecil, Drake, Mary Queen of Scots. For those schools taking another class subject in the lower standards, we suggest the following course for Standard V.:—

1. The Gunpowder Plot.
2. Sir Walter Raleigh.
3. The Petition of Right.
4. The Pilgrim Fathers.
5. Fall of Charles the First.
6. Oliver Cromwell and the Commonwealth.
7. The First Years of Charles the Second.
8. The Last of the Stuarts.
9. William and Mary.
10. Marlborough.
11. The '15 and the '45.
12. Clive.
13. The Great Commoner.
14. American War of Independence.
15. William Pitt the Younger.
16. The Act of Union, 1801.
17. Nelson.
18. Wellington and the Peninsular War.
19. The First Years of Queen Victoria's Reign.
20. The British Empire.

In Standard VI. this course would be followed by a detailed course on the present reign.

Answers to Correspondents.

D.B.—You can enter a training college for one year's training, upon the conditions laid down in Article 115 (*b*) of the Code.

R.C.G.—I do not think the Queen's Scholarship Examination is open to those who have passed the Certificate Examinations. If it were, I should certainly not advise you to take it again. Why not seek entrance into a college for one year's training? (Article 115 (*b*)).

W.C.—Pope's *Essay on Man*, by Morris (1s.); Macaulay's *Essay on Milton*, by Cotterill (2s. 6d.); Johnson's *Milton*, by Deighton (1s. 9d.). These are all published by Macmillan.

J.G.—I have very carefully considered your letter. It is difficult for me to pass judgment without fuller information. If you committed the indiscretion complained of upon the school premises during school hours, then the entry made was to some extent justifiable. If what you did was done out of school time, and off the premises, then the entry was unjustifiable. In any case, however, I hold that the person referred to acted illegally in making the entry.

J.R.P.—I regret keeping you waiting so long. I am not, however, to blame. It is always best to enclose two stamps, and so get a reply by post. 1. Yes; there is one published by Pitman and Sons, called *Pitman's French Weekly*. I believe it can be obtained at any bookstall. 2. *Advanced French Reader*, published by Messrs. Clive and Co. (2s. 6d.). 3. Yes; Ede and Sons, robe-makers, Chancery Lane, London, W.C.

N.Z.—I do not think you will find it an easy matter to procure a situation in New Zealand. Your best plan is to try and procure it through a clergyman. The bishop out there could no doubt help you, if you could get letters of introduction to him. You might also write to the Agent-General for New Zealand, Victoria Street, London, stating your wants and asking him how to proceed.

M.M.—If you offer French, you must prepare to recite seventy lines from a standard French author.

Puzzled.—Take up physiography. Gregory's book, published by Nelson and Sons, is very good.

Cwm.—It is only necessary for you to sit in the part you got a third in.

Indigent.—I strongly recommend you to take up the No. 1 course. You could not compete against a man from the older universities in classics. By taking up mathematics and science you will stand a good chance of a lectureship in one of those subjects.

E.N.—Blackie's English Classics Series: Armada, Ivry, Battle of Naseby, price 2d.

E.K.—You are qualified already as an assistant. I do not advise you to take the Queen's Scholarship Examination. Proceed to the Certificate Examinations. You should find no difficulty in getting a post in a higher-grade school. Watch the *Schoolmaster* and *Schoolmistress*.

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FOREIGN NOTES.

BY E. E. FOURNIER D'ALBE, B.SC., A.R.C.S.

Commercial or "business colleges" had their beginning in the United States more than fifty years ago. But their prosperity languished until the eighties, when the demand for shorthand writers and typists caused a rapid growth of the attendance. High-water mark was reached in 1894, when 518 of these schools were reported, with an aggregate roll of 115,748 students. That number has been reduced to half since then, partly by commercial depression, and partly by the fact that so many public high schools, as well as private colleges and academies, have established commercial courses in many respects superior to those offered by the majority of business colleges. The foremost among the commercial colleges are the Wharton School of Finance and Economy of the University of Pennsylvania, and the courses attached to the Universities of Chicago and California.

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The *Indian Journal of Education* points out that the resolution of the Government of India upon the progress of education during the past five years is a sweeping indictment of the policy of the local governments and of the action of the local educational departments. In the very first paragraph, "the Government of India regret that there is a marked departure in many respects from the principles laid down by the Indian Education Commission and accepted by the Government of India;" and the resolution goes on to indicate the principal points in respect of which local governments have sinned. Inspection work is inadequately provided for; district officers neglect the duty of village school inspection; private effort is not systematically encouraged; government institutions are favoured at the expense of aided institutions; no efforts are made by the education departments to gradually withdraw from the direct management of secondary schools; and so forth. It does not seem likely that, in these times of stress and strain, substantial progress will be made along the lines indicated.

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Some further particulars are now available with regard to the International School Congress which is to take place from 2nd to 5th August in Paris. The first section is to deal with domestic economy, and is to discuss the question whether instruction in this subject is to be given by the ordinary teachers or by specialists. School attendance is to be the subject of debate in the second section. This should bring out an interesting discussion, since the French law of 1882 has not worked very satisfactorily, and foreign authorities who have met with more success will probably be able to elucidate the many obscure points in this matter. Moral instruction will be discussed in the third section, and we may expect some lively divergences of opinion between spiritual and secular claimants. Higher elementary and continuation schools are to be the subjects of the fourth and fifth sections respectively.

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The first People's University in Paris seems to be in a fair way of being realised. The idea originated with a workingman of the name of Deherme. In his paper, *La Co-opération des Idées*, which he printed himself, he advocated the founding of a society for mutual instruction and the discussion of social and economic subjects. The society was founded, but it quickly grew to such dimensions that it was found necessary to enlarge its plan. Buildings devoted to the objects of the society have been secured in various parts of the city. They contain libraries, billiard-rooms, museums, and even a small theatre. Consultation rooms, baths, laboratories, dispensaries, temperance restaurants, employment agencies, and lodgings registries are to be added. Scientific and artistic excursions are planned. Membership is increasing by leaps and bounds. On the opening day eight hundred working-men joined, and paid their monthly contribution of fivepence. We may see the movement attaining larger proportions yet.

Elementary education in Servia is still in a somewhat primitive state. Legally, attendance at the elementary schools is compulsory; but the enactment is merely nominal, as there are not sufficient schools or teachers to cope with a full attendance. There are only about a hundred national schools for a population of two and a half millions, and the consequence is that only about one-third of the children go to school at all. The courses extend over four years, and are intended for ages varying from six to ten years. Servian language and history, arithmetic, geography, science, religion, and singing are the prescribed subjects. The secondary schools have a three-year course, and there are eleven state-aided "gymnasiums," which used to be open to the youth of both sexes, until separate high schools were established for girls. The universities have only philosophical, legal, and technical faculties, and it is therefore not surprising to see young Serbs visiting foreign universities in order to acquire a thorough academic training.

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It is somewhat surprising to find the American system of co-education of the sexes in full swing in Finland, a country which is credited rather with conservatism of ancient institutions than with a hankering after novelty. The first school on the American system was started in Finland in 1883. It was opposed both in private and in government circles, but the convictions of its founders proved too strong for the opposition. Some thirty "gymnasiums" have since been founded, open to both boys and girls, and elementary schools on the same system are found throughout the country. Madame Hagmann, who has managed one of these mixed schools for twelve years, is convinced that girls can do the same amount of mental work as boys, and are superior to the latter in the acquisition of foreign languages. It may be taken for granted that whatever the fate of mixed schools in the south of Europe, in the north they have come to stay. The Teutonic temperament seems to be particularly suited to them.

* * * * * *

It may possibly be some consolation for the Finns, in their struggle for national existence, to realise that all over Europe an intense and growing interest is taken in their national literature—a literature as rich and as perfect as that of any other modern nation, considering their numbers. The great Finnish epic, the *Kalevala*, and the *Kanteletar*, a collection of six hundred lyrical poems, were issued by Elias Lönnrot in 1835, and Finnish literature, then in imminent danger of being swamped by Russian and Swedish influences, was saved, and enabled to enter upon a new period of brilliant development. To judge from the analogy of the Welsh language, with its rich and highly-developed modern literature and press, it is extremely unlikely that the Finnish literature will be eclipsed or stunted in its own vernacular growth. The modern facilities offered in the way of cheap printing and distribution tend to ensure the permanence of national literatures, to the clear benefit of the world at large.

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The Dutch Government report on the teaching of English in Dutch training colleges presents a peculiar interest to English readers. The document complains of the lack of training in the translation and use of English idiomatic expressions, and proposes to pay more attention to this branch of the language in future than to the grammar. Such expressions as "pay attention to," and "put in mind of," are quite foreign to Dutch or German usage, and present serious difficulties to the beginner in English. The reading of Swift, Addison, and Macaulay is not sufficient training for daily and verbal use of the English language. One would have supposed that any modern English novel with plenty of dialogue would be better adapted to that particular purpose. In the higher examinations, the report points out that "the history of the English language cannot be effectively mastered without a knowledge of Anglo-Saxon," and that some acquaintance with other old German dialects and with old French is necessary for anything like a complete appreciation of its historical development. Anglo-Saxon has therefore been added to the curriculum.

OUR TUTORIAL SECTION

OUR PUPIL TEACHERS' AND SCHOLARSHIP COURSE.

BY ARTHUR T. FLUX,

Head-Master of the Belvedere Pupil Teachers' Centre, First on Scholarship List, Author of "Scholarship School Management."

SPRING EXAMINATION, 1900.

Twelfth Month—March.

WORK TO BE PREPARED.

THE last month may well be devoted to revision of all the important points which have been noted during the year.

1. READING.

This must not be neglected. The meanings of all words and phrases must, where necessary, be looked out. Oral practice is very essential.

2. ENGLISH.

The parsing and analysis generally constitute the compulsory questions, and each student should be absolutely sure of every sentence and word. All allusions must be looked up and thoroughly understood. Lives of the authors should be prepared, and something should be known of their chief works, and also of the writers who were contemporary with them. Candidates must, in addition, be prepared to explain the meaning of the ordinary terminations of English words, giving in each case (*a*) the meaning of the suffix, and (*b*) its function in changing noun to adjective, etc. First Years must prepare the prefixes and "first elements of etymology," which means a knowledge of how words are derived, and of the chief Latin and Greek roots. Second Years are expected to have an acquaintance with the "elementary history of the language, and a knowledge of common errors in written and spoken language." All these points are fully covered by the *Pupil Teachers' English Notebook* (T. Nelson and Sons).

3. HISTORY.

In revising this subject, notebooks, if they have been properly kept, will be found most useful. Dates, genealogical tables, plans of battles, chief statutes, wars and treaties, lives of leading men, should receive final attention.

In answering the questions at the examination, the greatest care must be exercised to put down *facts*. Vague and general statements, without dates and the names of persons and places, are quite useless. Lack of clearness and definiteness is the greatest fault of pupil teachers generally. Tabulate answers where convenient.

4. GEOGRAPHY.

The same remarks apply to this subject. Facts and maps are worth pages of hazy statements. As no particular memory-maps are set, sketch-maps must accompany *all* answers where possible. If asked to "say what you can about any country," arrange answer under boundaries, extent, physical features, climate, productions, people, towns, government, etc.

5. ARITHMETIC.

Recent examinations show that increased importance is attached to method, and to a thorough knowledge of the theory. Merely getting a correct result is of less importance than showing ability to recognise the quickest and easiest way to work the problem. All sums should be accompanied by sufficient verbal explanation to make the method adopted quite clear.

6. SCIENCE.

Pupil teachers who take the Science paper (and *all* should) must take particular care to answer the question clearly, and not to introduce extraneous and useless information.

A complete test examination is appended. Students who desire to have their papers marked and criticised may send them to me with a postal order for two shillings. The papers should be worked under examination conditions, and in the exact time allowed.

Test Examination.

(The numbers in brackets are the marks assigned to each question.)

CANDIDATES.

GEOGRAPHY.

(Time, 1 hour. 80 marks. Answer three questions.)

1. Give the chief divisions (*a*) of the land, (*b*) of the water of the globe. What countries are comprised in Asia? (30)
2. Describe, with sketch-map, the south coast of England. (25)
3. Say what you can of the islands on the west coast of Scotland. (25)
4. What are the chief Irish ports? State, with each, what is exported and what is imported. (25)
5. Where and what are the following:—Bog of Allen, the Downs, the Potteries, Glenmore, Dartmoor, and Fingal's Cave? (25)

HISTORY.

(Time, 1 hour. 80 marks. Answer three questions.)

1. Say what you can of Alfred. Why was he called "the Great"? (30)
2. What was the Magna Charta? How did it come to be signed? (25)
3. Who were the Lollards, the Puritans, the Jacobites, the Fenians? (25)
4. Write a life of Marlborough, or Nelson, or Wellington. (25)
5. Write about twenty lines on the advance made during the present reign. (25)

ARITHMETIC.

(Time, 1 hour. 100 marks. Answer three questions.)

1. (*a*) How would you explain to children the reason for the rule for finding the G.C.M. of two numbers?

(*b*) What is the G.C.M. of $15 \times 17 \times 19$, $13 \times 15 \times 17$, $19 \times 15 \times 23$?

(*c*) The G.C.M. of two numbers is 35. The first contains the factors 11 and 13, not common to the second; and the second the factors 7 and 17, not common to the first. Find the numbers. (40)

2. Write in words $\frac{8}{9}$. What fraction of itself must be added to it to make unity? Write down a fraction with three digits in both numerator and denominator equal to it. (30)
3. Simplify—

$$\frac{\frac{8}{15}+\frac{9}{23}}{\frac{8}{17}+\frac{7}{16}} \times \frac{\frac{4}{11}+\frac{21}{17}}{\frac{11}{15}+\frac{17}{19}}. \quad (30)$$

4. Express $\frac{1\cdot\dot{5}47\dot{8}\times 10\cdot 618}{2\cdot 654\dot{7}}$ in its simplest form. (30)
5. Find the price of fourteen dozen silver spoons, each spoon weighing 2 oz. 13 dwt. 18 grs., at 5s. per oz. (30)

ENGLISH.

(Time, 1 hour. 80 marks. Answer three questions.)

1. Analyse the following:—

> "'*Thanks*, noble Surrey!' Marmion said,
> Nor *farther* greeting there he paid;
> But, *parting like a thunderbolt*,
> *First* in the vanguard made a halt,
> Where *such* a shout there rose
> .....that the cry.....
> Startled the Scottish foes." (30)

2. Parse the words in italics. (25)
3. Explain the meaning and use of the suffixes in the following words, and give other examples:—vaward, salutation, desperately, precious, movement, matchless. (25)
4. Write explanatory notes on the following:—The Master;

Old Bell-the-Cat; Flodden had been Bannockburn; Twisel glen; Bernardine brood; Edmund, the Admiral. (25)

5. Explain—quoting examples from the poem—Nominative of Address, Extension of the Predicate, and Infinitive Mood. (25)

Essay.

(Time, 30 minutes. 40 marks.)

Write a short essay on one of the following subjects:—

(*a*) The Present War in South Africa.
(*b*) The Importance of Punctuality.
(*c*) The process of some manufacture.

Music.

(Time, 15 minutes. 15 marks. Answer three questions.)

1. Give two examples of the same intervals as are found between *doh* and *fah*, *soh* and *te*, *me* and *soh*. (5)

2. Rewrite the following an octave higher, doubling the value of each note and rest:—

$$\left\{ \left| \mathbf{s}_1 \;:\mathbf{t} \;\middle|\; \mathbf{r}_1 \;.\;:\;.\mathbf{f} \;\middle|\; \mathbf{m} \;:\mathbf{d}^1 \;\middle|\; \mathbf{s} \;:- \;\right\| \right. \quad (5)$$

3. What is the standard scale of pitch?

Elementary Science.

(Time, ¾ hour. 100 marks. Answer three questions.)

1. A bottle weighs 2 oz. When holding 3½ oz. of shot, it will just float in water; when holding 3 oz., it will just float in oil; and when holding 3¾ oz., it will just float in brine. Find the specific gravity of oil and brine. (40)

2. A piece of cardboard, 9 inches long and 6 inches broad, is divided in six equal squares by means of a ruler and pencil. One of the two squares that are not corner squares is cut away with a penknife. Find the centre of gravity of the remainder of the cardboard. (30)

3. Explain the terms "foot pound" and "horse power." How much work is done in raising twenty-five weights of 56 lbs. each from the ground to a height of 4 feet? (30)

4. Explain how a weight, pulley, and chain can be arranged so as to make a door shut when let go. Draw a diagram. What forces has the weight to overcome as it shuts the door? (30)

5. A boy flies a kite. What forces are acting on the kite when it is at rest in the air? Draw a diagram to show direction of each. Explain why the string must not be tied to the lower part of the kite. (30)

First Year.

Geography.

(Time, 1 hour. 80 marks. Answer three questions.)

1. What do you understand by the "German Empire"? Explain fully how it is governed. (30)

2. What are the chief industries of France? Where are they carried on? (25)

3. Say what you can of Siberia. (25)

4. Write about twenty lines on the advance in India since 1858. What does "Kaiser-i-Hind" mean? (25)

5. Where and what are the Landes, the Sunderbunds, the Tundras, the Riviera, the Crimea, the Carnatic? (25)

History.

(Time, 1 hour. 80 marks. Answer three questions.)

1. Give an account of the conquest of England *after* the battle of Hastings. (30)

2. What were the chief points of Henry the First's Great Charter? (25)

3. Trace the growth of Parliament during the period you have studied. (25)

4. Show by a genealogical table the rival houses of York and Lancaster, and give, with dates, the chief battles fought. (25)

5. How did the Dissolution of Monasteries affect the poor in Tudor times, and how was the distress alleviated? (25)

Arithmetic.

(Time, 1 hour. 100 marks. Answer three questions.)

1. (*a*) Define ratio and proportion.
(*b*) The first, third, and fourth terms of a proportion are 3 cwt. 14 lbs., £1, 7s. 1d., and £5, 1s. 10d. respectively. Find the second term. (40)

2. After paying 7d. in the £ income-tax, a gentleman had £971, 16s. 1d. left. On what amount was the tax charged? (30)

3. A cask which holds 20 gallons is filled with 15 gallons of brandy and 5 of water. Four gallons of the mixture are drawn off, and the cask is again filled with water. Find the percentage of brandy in the second mixture. (30)

4. At what rate per cent. does the simple interest on £372, 10s. for eighteen years amount to £301, 14s. 6d.? (30)

5. A litre of hydrogen gas weighs ·0896 grammes. Find the volume occupied by 1 lb. of this gas. (1 litre = 1·7602 pints.) (30)

English.

(Time, 1 hour. 80 marks. Answer three questions.)

1. Paraphrase the following:—

> "*Such* are the charms to barren states assigned,
> Their wants *but few*, their wishes all confined.
> *Yet* let them *only* share the praises due;
> If few their wants, their pleasures are but few,
> For *every* want that stimulates the breast
> Becomes a *source* of pleasure when redrest." (40)

2. Analyse the above, and parse words in italics. (30)

3. Give the etymology of the following words:—stimulates, indurated, superfluous, dishonourable, subjected. (30)

4. Give in your own words Goldsmith's estimate of the English character. (30)

5. What are the different kinds of sentence you recognise? Define each, and give two examples taken from the poem. (30)

Music.

(Time, 15 minutes. 15 marks. Answer three questions.)

1. Rewrite the following without change of key:—

$$\mathbf{s\ m\ {}^fd\ m\ r\ l_1\ t\ d\ s\ m\ {}^rs\ m\ d} \quad (5)$$

2. Name the following intervals:—

$$\mathbf{d-fe,\ fe-t,\ r-ta,\ ta_1-s} \quad (5)$$

3. Write the following in four-pulse measure:—

1	½	¼	¼	1	½	½	¼	¼	½	½	½	¼	¼	1
d	**m**	**r**	**s**	**m**	**f**	rest	**d**	**m**	**l**	**s**	rest	**m**	**f**	**d**

(5)

Essay. (See under *Candidates*.)

Algebra.

(Time, ½ hour. 50 marks. Answer two questions.)

1. If $a = 4$, $b = 3$, $c = 2$, $d = 1$, find the numerical value of—
(1) $\{(a-b)(c+d)-(a-c)(b-d)\}(a-d)$.
(2) $b^c - c^b$.
(3) $\sqrt[b]{a^2+3b+c}$. (25)

2. Show that $(a-b)(a+b-c)+(b-c)(b+c-a)+(c-a)(c+a-b)=0$. (25)

3. Solve the equations—
(1) $\frac{x-1}{7}+\frac{23-x}{5}=7-\frac{4+x}{4}$.
(2) $2x-\{(2x+1)-(3x-b)\}=35-3[2x-\{10-(2x-1)\}]$. (25)

Euclid.

(Time, ½ hour. 50 marks. Answer two questions.)

1. Define circle, parallel straight lines, plane rectilineal angle. What do you understand by axiom, postulate, corollary? Write out the postulates. (20)

2. If two angles of a triangle are equal, the sides also which subtend or are opposite those angles shall be equal. (20)

3. The diagonals of a rhombus bisect each other at right angles. (30)

Elementary Science.

(Time, ¾ hour. 100 marks. Answer three questions.)

1. On a cold morning a gardener grasps the iron part of his spade with one hand and the wooden part with the other. Explain why one hand feels colder than the other. (30)

2. The sun shines through a crack in the shutter of a darkened room. A person inside the room says that he sees a ray of light entering the room. Put his statement in a more accurate form. What can he really see? (30)

3. Explain clearly what takes place when a ray of sunlight is passed through a triangular prism. Draw a diagram. (30)

4. Explain carefully what happens when the water in a pond sinks in temperature from 50° to 30° F. Why does ice float? (30)

5. A man looks through a thick glass window at a candle above the level of his eye. Draw a diagram to show the passage of a ray of light from the candle to his eye. Explain why the candle is not seen in its true position. (40)

Second Year.

Geography.

(Time, 1 hour. 80 marks. Answer three questions.)

1. What do you understand by the "Dominion of Canada"? Enumerate the provinces and territories included in it, and say what you can of its mineral wealth. (30)
2. Say what you can of the British possessions on the west coast of Africa. (25)
3. Write a letter, as from a resident in California, describing the country, its productions, etc. (25)
4. Mention the native races under English rule, and give a short account of two of them. (25)
5. Write about twenty lines on (*a*) the British occupation of Egypt, or (*b*) the causes of the present war in South Africa. (25)

History.

(Time, 1 hour. 80 marks. Answer three questions.)

1. What are the chief points on which the Stuart kings and their parliaments differed? When and how were they finally settled? (30)
2. Say what you can of the causes and results of the War of the Spanish Succession. (25)
3. Write four or five lines about four of the following:—Dr. Sacheverell, the Darien Scheme, South Sea Scheme, Gordon Riots, Catholic Emancipation, Navarino, Cato Street Conspiracy. (25)
4. Give a brief account of the Peninsular War. (25)
5. Point out in what directions the empire has been extended during the present century. (25)

Arithmetic.

(Time, 1 hour. 100 marks. Answer three questions.)

1. Find the expense of carpeting a room 12 feet 4 inches broad, by 12 feet 6 inches long, with carpet $\frac{3}{4}$ yard wide, at 4s. 6d. per yard. (30)
2. Find the compound interest on £254 in 3 years 5 months at 3 per cent. per annum. (30)
3. A man takes for the expenses of a tour £20, 18s., and finds at the end of 6 days that the money which he had spent was equal to ·809523 of what remained. Find his average daily expenditure. (30)
4. Bank stock in October paid 5½ per cent. A person, after the deduction of 4d. in the £ on her dividend, received £25, 16s. 3d. How much bank stock did she hold? (30)
5. There are two rectangular wells, one of them 5 feet by 4 feet in section, the other 6 feet by 3½ feet. A hose which fills the first in 4 minutes would take 7 minutes to fill the other; and the water which would fill the smaller well, if poured into the larger one, would stand 15 feet below the top. What is the depth of each well? (40)

English.

(Time, 1 hour. 80 marks. Answer three questions.)

1. Point out the important changes which took place in the language of this country at the Norman Conquest. (30)
2. Describe, with quotations, the quarrel between Brutus and Cassius. (25)
3. Explain the following, giving the context if you can:—cautelous, ceremonies, tag-rag, bear me hard, fearful bravery, orts, phantasma. (25)
4. Explain the following:—
   (*a*) He hath the falling sickness.
   (*b*) Be factious for redress of grievances.
   (*c*) They fall their crests, and like deceitful jades sink in the trial.
   (*d*) I held Epicurus strong.
   (*e*) You'll bear me a bang for that.
   (*f*) Unicorns may be betrayed by trees. (25)
5. Correct the following if necessary, pointing out the errors:—
   (1.) The effluvia was disgusting.
   (2.) Let each esteem other better than themselves.
   (3.) He was one of the wisest men that has ever lived.
   (4.) Having finished the chapter, the volume was shut.
   (5.) This paper possesses the largest circulation of any other daily paper.
   (6.) Shakespeare is greater than any dramatist. (25)

Music.

(Time, 15 minutes. 15 marks. Answer three questions.)

1. Rewrite the following passage, making a change to the first sharp key at (*a*), and a return to the original key at (*b*):—

(*a*) (*b*)

s d r t_1 n fe l s fe t d' fe s r f t_1 d (5)

2. Which of the following notes is highest in pitch, and which lowest:—**f** in key **A**, **l** in key G, **s** in key B flat, $\mathbf{t_1}$ in key C, **d** in key D? (5)
3. Explain the meaning of the following terms:—(*a*) *legato*; (*b*) *dal segno*; (*c*) *sforzando*; (*d*) *ad lib.*; (*e*) *allegretto*. (5)

Euclid.

(Time, 30 minutes. 50 marks. Answer two questions.)

1. The opposite sides and angles of a parallelogram are equal to one another, and the diagonal bisects it. The diagonals of a parallelogram are equal; find its angles. (20)
2. In any right-angled triangle the square on the hypotenuse is equal to the sum of the squares on the other sides. Write out the converse proposition to this. (20)
3. In any triangle, ABC, draw a straight line, DE, parallel to the base, so that DE shall be equal to the sum of DB and EC. (30)

Algebra.

(Time, 30 minutes. 50 marks. Answer two questions.)

1. Find the product of

$$(x^4 + x^2y^2 + y^4)(x^4 - x^2y^2 + y^4)(x^2 + y^2)(x^2 - y^2),$$

and divide

$$a^3 + 8b^3 + 27c^3 - 18abc \text{ by } a + 2b + 3c,$$

performing the operation on three lines if you can. (20)

2. Solve—

$$(a)\ \frac{7x+6}{23} + \frac{9x-1}{10} - \frac{2x-3}{15} = 10.$$

$$(b)\ \left.\begin{aligned}(x+5)(y+7) - (x+1)(y-9) &= 122\\ 3y - 2x &= 9\end{aligned}\right\}. \quad (20)$$

3. A four-sided field has one square corner, and the two sides that form this corner are 36 yards and 15 yards long respectively; each of the other two sides is 32½ yards long. Find the area of the field. (30)

Essay. (See under *Candidates.*)

Elementary Science.

(Time, ¾ hour. 100 marks. Answer three questions.)

1. Which of the following bodies are elements:—air, chalk, coal-gas, diamond, iron, mercury, salt, soot, sulphur, water? Give your reason for thinking that any one of the ten is not an element. (30)
2. How can you prepare hydrogen? How would you exhibit its properties to a class? What substance is produced when hydrogen is burned in air? (30)
3. A bar magnet is broken into four pieces. Describe the magnetic condition of each piece. How can you prove the truth of your answer? (30)
4. Two compasses are put near together on a table. In what position may the needles be expected not to disturb one another? How will the needles behave when one compass is put to the magnetic north-west of the other? (40)

AUTUMN EXAMINATION, 1900.

Sixth Month—March.

Work to be Prepared.

1. Reading and Repetition.

Continued oral practice, with due attention to emphasis, modulation, clear enunciation and articulation.

2. English.

Candidates.—Marmion, Canto vi., lines 569 to 680.

First Year.—The Traveller, lines 239 to 296, with twenty roots and meanings each week, and the derivations of the most important words in the passage set for preparation.

Second Year.—Julius Cæsar, Act iii., Scene 2.

All notes, meanings of allusions, derivations, etc., must be prepared.

3. Essays.

Write one or two essays each week, selecting from the following:—Holidays, The Penny Post, Cheerfulness, Paper-making, Knowledge is Power, Fairy Tales, Fishing.

4. History.

Candidates.—The Tudors, 1485–1603.
First Year.—The Lancastrian Kings, Henry IV. to Henry VI.
Second Year.—William and Mary. Anne.
} Notes below.

5. Geography.

Candidates.—The counties of Wales.
First Year.—Asia: the physical features, climate, and productions.
Second Year.—British North America.

6. Arithmetic.

Candidates.—Recurring Decimals.
First Year.—Compound Interest.
Second Year.—Continue practice in Stocks and Shares.

7. Euclid.

First Year.—Props. 17–20, and four deductions each week.
Second Year.—Revise definitions, axioms, and postulates, and Props. 1–6, with eight deductions each week.

8. Algebra.

First Year.—Continued practice in factors.
Second Year.—Simple equations, and problems thereon.

9. Music.

All Years.—Finish the syllabus set, and work weekly a set of questions.

Notes on the Month's Work.

1. English. (For full notes, see October number.)

2. History.

Candidates.—The Tudor period is one of great importance—an era of new movement, new statesmanship, new thought, and new development—and hence requires careful study. Note the causes of the high prerogative exercised by the Tudors: (1) the decay of the great baronial houses, which no longer could put a check upon the king; (2) the new and subservient aristocracy; (3) the power of the Commons not yet developed; (4) the general desire for peace; (5) personal character of the Tudors themselves. Henry the Seventh amassed money by various means—which must be observed. His marriage schemes are important in their issues. The marriage of Prince Arthur to Catherine of Aragon brought about the Reformation in England; that of Margaret to James the Fourth of Scotland, the Stuart dynasty of kings. The Revival of Learning and the Reformation in England are topics of immense importance.

First Year.—The Lancastrian kings. Chief points:—The plots against Henry the Fourth; the growth of the influence of Parliament; the Lollards and the Statute De Heretico Comburendo; Henry the Fifth's brilliant campaign in France; Henry the Sixth's minority, with its attendant evils; loss of France; discontent in England, and the events leading up to the Wars of the Roses. Prepare a good genealogical table showing the Lancastrian, Yorkist, and Beaufort lines.

Second Year.—William and Mary. Note the vast importance of the Bill of Rights, as settling for ever the points of dispute between the king and the Parliament; the reduction of Ireland and Scotland; the Mutiny Bill; the Triennial Bill; the beginning of government by party, and the foreign policy which was to curb and curtail the power of Louis the Fourteenth. The last was continued in Anne's reign in the War of the Spanish Succession, with Marlborough's splendid victories, and the somewhat disappointing issue of the whole war. The Union with Scotland must be carefully studied, and the political importance of Dr. Sacheverell's trial.

3. Geography.

In all years the same process of preparation must be followed. Draw plenty of sketch-maps, and practise them till known.

Second Year.—Pay especial attention to the productions, imports, and exports. All students should obtain from the Agent-General for Canada the excellent handbooks issued on the provinces, giving the most recent information. Klondike and its goldfields demand attention. Note the term "Dominion of Canada," what it really means; the effects produced by federation.

The difficulty with the French over their fishing rights on the coast of Newfoundland requires a few words. When Newfoundland was ceded to England, a clause in the treaty reserved to the French the islands of St. Pierre and Miquelon, and the right to use the coast for drying their fish—that is, cod. The evident intention was to afford them an opportunity, equal to that of the settlers, of preserving their harvest of the sea. Since then the French have attempted to make the meaning of the treaty to be that they have the *exclusive* right to the coast, not only for salting or drying cod, but also for fishing and canning lobsters. This has led to much ill-feeling and unpleasantness between the colonists, England, and the French. Unfortunately the difficulty is not yet settled.

4. Arithmetic.

The rules with regard to conversion of recurring decimals into vulgar fractions and *vice versâ* must be clearly understood. All candidates should be able to recognise the *sevenths* expressed as decimals—for example, $\frac{1}{7} = \cdot\dot{1}4285\dot{7}$, $\frac{2}{7} = \cdot\dot{2}85714\dot{2}$, etc. The same figures occur in the same order, but starting at a different digit. All good text-books point this out, but students fail to realise the importance of it. Questions such as the following continually occur in examination papers: "Reduce to a vulgar fraction ·3857142." By the ordinary method this is a tedious process. If, however, the *sevenths* are known, it becomes—

$$\cdot 3\tfrac{6}{7} = \frac{3\tfrac{6}{7}}{10} = \frac{27}{70}.$$

First Year.—In working compound interest, adopt the fractional method. For example, Find the compound interest on £4000 for three years at 5 per cent. Now 5 per cent. = $\frac{5}{100}$, or $\frac{1}{20}$ of the capital to be added each year. The sum should be stated thus:—

Principal	=	£4000	0	0
First year's interest = $\frac{1}{20}$ of £4000	=	200	0	0
Second year's principal	=	£4200	0	0
Second year's interest = $\frac{1}{20}$ of £4200	=	210	0	0
Third year's principal	=	£4410	0	0
Third year's interest = $\frac{1}{20}$ of £4410	=	220	10	0
Total at end of three years	=	£4630	10	0
Therefore interest	=	£630	10	0

It is also better to work in decimals than to work out to shillings and pence.

5. Euclid.

Practice must be taken in writing out propositions against time, and in using other letters than the first seven.

Test Questions.

1. *Penmanship.*
   Large Hand:—*Superfluity.*
   Small Hand:—*A land of tyrants and a den of slaves.*
   (Use the *Practical Teacher Copy Book* regularly.)

2. *English.—Candidates.*
   (*a*) Analyse:—"'I thought *to slay* him *where* he stood.
   'Tis pity of him too,' he cried;
   'Bold can he speak and fairly ride,
   I warrant *him* a *warrior* tried.'"
   (*b*) Parse the words in italics.

First Year.
   (*a*) Paraphrase lines 227–238.
   (*b*) Analyse:—"Some sterner virtues .....
   ..... in a kinder sky."
   (*c*) Parse *like their pleasures, such as play, to sport.*

Second Year.
   (*a*) Paraphrase:—"I could well be moved.....
   .....to keep him so."
   (*b*) Analyse:—"Yet, in the number.....
   .....to keep him so."
   (*c*) Parse:—"And that I am he, let me a little show it even in this."

3. *History.—Candidates.*
   (*a*) What do you know of the Lollards? In what did they differ from the orthodox churchmen of the day?
   (*b*) Draw a genealogical table showing the descent of the Lancastrian, Yorkist, and Beaufort families.

First Year.
   (*a*) Give an account of the declining years of Edward the Third's life.
   (*b*) What causes led to the Peasants' Revolt, and what where the chief results?

Second Year.
   (*a*) What do you know of Monmouth's Rebellion?
   (*b*) What was the Declaration of Indulgence? Why was there such opposition to it from some of the people whom it would have relieved?

SCHOLARSHIP EXAMINATION, 1900.

Third Month—March.

WORK TO BE PREPARED.

1. *Reading, Repetition, and Penmanship.*—A few minutes' daily practice.
2. *Theory of Teaching.*—Chap. iv., *Scholarship School Management.*
3. *Geography.*

(1.) Revise Spain and Portugal, Italy, Turkey, Greece, Balkan Provinces.

(2.) Australia: physical features, climate, productions.

4. *History.*—Edward I. to Richard II.
5. *Composition.*—One or two essays each week on such subjects as—Free Libraries, The British Constitution, Trade Follows the Flag, Sweet are the Uses of Adversity, Night, Flowers, The Differences between Poetry and Prose.
6. *English.*

(1.) The grammar of the pronoun; derivation, classification, inflections, syntax, etc.

(2.) Twenty-five roots and meanings each week.

(3.) The history of the language from 1400 to 1600.

(4.) *Julius Cæsar*, Act ii.

7. *Arithmetic.*—Decimal fractions.
8. *Algebra.*—Simple equations, and problems thereon.
9. *Euclid.*—Book I., Props. 21–30, and six deductions per week.
10. *Elementary Science.—Radiation:* rectilinear propagation of radiation; reflection and refraction of radiation. Analysis of light by a prism, and its recomposition. The colour disc. The visible spectrum.
11. *Languages.*

Latin, *Pliny's Letters*, No. 4. } Translation and retranslation.
French, *Le Trésor*, three pages. } Exercises in grammar.

12. *Drawing.*—A freehand copy each week. Geometry: similar figures.
13. *Music.*—Chap. iii., *School Music Teacher.*
14. *Domestic Economy.*—Preparation of food. Various methods of cooking; the reasons for each, and the joints suitable for each. Methods of preserving food.

Notes on the Work for the Month.

Geography.—In preparing the geography of the various colonies, students are strongly advised to procure the illustrated pamphlets and books issued by the agents-general of the different colonies. Much useful information can always be obtained at the trouble of writing a letter.

History.—Chief Points:—

Edward I.—Reduction of Wales and Statute of Wales.
War with Scotland.
Legislative measures and reforms—
1275. *First Statute of Westminster.*
1278. *Quo warranto*—inquiry into the rights of landowners.
1279. *Mortmain*—forbidding the alienation of land to religious bodies, etc.
1285. *Second Statute of Westminster*, amplifying Law of Entail.
1285. *Statute of Winchester.*—Police regulations, originating Justices of the Peace.
1290. *Quia emptores*—to prevent loss of feudal profits by subinfeudation.
1297. *Confirmatio Chartarum* (also in 1298, 1299, 1300, 1301).

Judicial reforms—
1. Distinct staff of judges to each court.
2. Court of Exchequer: causes affecting revenue.
3. Court of Common Pleas: causes between private persons.
4. Court of King's Bench: causes affecting the sovereign.

Edward II.—Favourites; War with Scotland; Bannockburn; Deposition.

Edward III.—Hundred Years' War.
Causes—
1. Support given by Philip the Sixth to the Count of Flanders against the towns which mainly supported English wool trade (*chief* cause).
2. Support given by French to the Scots.
3. Attempt of French king to gain absolute possession of Aquitaine.
4. *Consequent* assumption of title and claim.

Black Death and Statute of Labourers; Statute of Provisors and Treason; Troubles at end of reign; "Good Parliament."

Richard II.—Peasants' Revolt (most important); The Lollards; Statute of Præmunire; Lords Appellant and Merciless Parliament; Causes leading to deposition.

This period requires very careful study, especially with regard to the great movements which came into prominence during the century and a quarter over which it extends. The gradual decentralisation of the judicial powers was rendered necessary by the increasing population, and more especially by the increasing number of small landholders.

The condition of the ordinary labourers or villeins constituted a grave danger to the state. Their enlightenment by contact with other people, their desire for emancipation from the servile condition in which they were bound down, the Black Death and Statutes of Labourers, Wycliffe's teaching, and more particularly the socialistic doctrines promulgated by his "poor preachers," the heavy market tolls, the tenure of land on personal service, all combined to bring about the revolt of Richard's reign. The growing discontent with the church and its lack of practical assistance is evinced by the rapidity with which the Lollard doctrines spread throughout England.

It was during this period also that England was gradually becoming one people, with one speech. The line of demarcation between Norman and English was rapidly fading away.

English.—The two main points to which attention must be directed in the study of the history of the language from 1400 to 1600 are: (1) the invention of printing, which permitted of the rapid multiplication of books at a much smaller price than had hitherto obtained, and which *fixed* the form of the language; and (2) the great "revival of learning." Contrast the barren state of Henry the Third's reign (from the standpoint of writers and literature) with the reign of Elizabeth, and it will at once be seen that there must have been a tremendous force at work to produce the crowd of eminent writers which appeared at the end of the Tudor period. The decay of the Mystery Play and Passion Play after the dissolution of the monasteries led to the rise of the drama bearing on secular events.

In the "Cæsar" set there is also much to be carefully studied. All difficulties not explained by the text-book used should be sent up for solution.

Arithmetic.—The *theory* of decimals is most important. Reduction of vulgar fractions to decimals, proof of the rule, rules by which it may be ascertained at sight whether a fraction can be represented by a finite decimal, the limitation of the number of figures in the quotient before a decimal recurs, must be thoroughly known.

Test Questions.

1. Penmanship.
Large Hand:—*Afghanistan.*
Small Hand:—*The noble stag was pausing now*
Upon the mountain's southern brow.

2. What do you know about the times and causes of the periodical rise and fall of the Indus and of the Mahanadi?

3. What manufactures and exports of India have lately developed most? What are the chief reasons of the development?

4. The tyranny of King John combined for the first time the barons, clergy, and people against the crown. Show from the provisions of the Magna Charta the main privileges which each party sought to establish.

5. What were the chief administrative reforms introduced by the Angevin kings?

6. "An adjective is a word which describes or points out a noun." Discuss this definition, and if you think it bad, say what you would substitute for it, and why.

7. Define "food." In nitrogenous and carbonaceous foods, what other elements are usually present besides nitrogen and carbon respectively? Give an analysis showing the constituent elements of eggs and of bread.

CORRESPONDENCE: RULES.

To ensure an answer in the next issue, queries must be sent by the 15th of each month.

Name and address of sender, with coupon of current number of THE PRACTICAL TEACHER (and *nom de plume* if desired), must be enclosed.

As a rule, all replies will appear in the Correspondence Column; but any one desiring an immediate reply may obtain it by enclosing a stamped addressed envelope.

All communications and queries with regard to the PUPIL TEACHERS' AND SCHOLARSHIP COURSE should be addressed to "Mr. A. T. FLUX, The Bays, Belvedere, Kent."

ANSWERS TO CORRESPONDENTS.

Orchid.—15/20. The facts and thoughts given are too childish for a P.T. Think your subject out before commencing to write.

A. H. T.—A detailed syllabus is issued by the Education Department. Write for it.

H. Y.—I have answered the query several times. The marks in science and drawing will be given *only* on the work done at the examination.

(*Other correspondents answered by post.*)

OUR CERTIFICATE COURSE FOR 1900.

BY GEORGE COLLAR, B.A., B.SC.,
Head-Master of the Stockwell Pupil Teachers' School.

TEST QUESTIONS ON THE FEBRUARY WORK.

Theory of Teaching.

First Year.—Point out the fallacy in the following:—

(*a*) Fishes are animals that can swim; the dog can swim, therefore the dog is a fish.

(*b*) Sambo inhabits London; the inhabitants of London are white, therefore Sambo is white.

(*c*) The earthworm has no bones; sea-anemones have no bones, therefore the earthworm is a sea-anemone.

Second Year.—1. What is meant by a "judgment"? Classify judgments, and the need of training in the matter of forming judgments.

2. What are the mental states that precede the formation of a judgment?

Arithmetic.

1. A sold a horse to B at a profit of 20 per cent., and B resold it to A at a loss of 20 per cent. How much per cent. did A gain or lose?

2. A merchant bought a cargo of tea, and sold 25 per cent. of it at a profit of 25 per cent., and 45 per cent. of it at a profit of 10 per cent.; on the remainder he lost 2 per cent. What was his gain or loss per cent. on the whole?

English.

First Year.—1. Give the Old English forms of the first personal pronouns.

2. Give a brief analysis of Johnson's *Life of Milton*, and set out in more detail the parts dealing with the production of *Paradise Lost*.

Second Year.—1. Write an epitome of Leigh Hunt's *Essay on Angling*.

2. Who were the chief captains summoned by Satan?

3. Explain—"Gehenna;" "If any rest can harbour there;" "Moors by his side under the lee;" "The Stygian flood."

Geography.

Both Years.—1. Give an account of German commerce, saying how it is being fostered, and in what directions it is being extended.

2. Describe the industries of Denmark, and account for the prosperity of Danish agriculture.

3. What are the chief means of communication *through* Switzerland between the neighbouring countries?

History.

Both Years.—Discuss the causes which led to the American War of Independence, and contrast it with the war now going on in South Africa.

NOTES AND SYLLABUS FOR MARCH.

English Composition.

Both Years.—Prepare and write essays on the following subjects:—

1. Generosity.
2. Railways.
3. The use of books.

[*N.B.*—Read Ruskin's *Sesame and Lilies* before attempting number three.]

Theory of Teaching.

First Year.—*The teaching of geography.* Suitability of the subject to the elementary school curriculum; not so much from utilitarian reasons. We do not go through all this work to afford the few pupils who will travel a little information which will be out of date before they are old enough to start, nor yet to benefit those entering on commercial pursuits. We endeavour to train the child's (*a*) *observation*, by making him notice the physical features around him; (*b*) *imagination*, by trying to get him to picture to himself scenes and circumstances far away by comparing them with what he has seen; (*c*) *reasoning powers*, by leading him to trace the connection between cause and effect—for example, climate as result of position and altitude, trade routes as founded on the construction of the country, and population as depending on the supply of commodities. Notice how the principle of proceeding from the known to the unknown calls upon us to start with the plan of the room and proceed outward. (See the article on teaching geography in Germany in a recent number of The Practical Teacher.)

Logic.—Study Jevons, chap. xviii. Notice carefully how irregular and compound syllogisms may be reduced to the normal and simple form. This part of the subject requires a great deal of practice, and the student must work plenty of exercises, of which he will find abundance in any piece of prose which is at all argumentative.

Second Year.—*Apperception.* Great importance is attached by all modern educationists to this portion of the subject, and the student is advised to read Lange's *Apperception*, translated by De Garmo (Isbister). The first section of the book, on the *theory* of apperception, is a little difficult in places; but the second, on its *application*, is very valuable. The little work by De Garmo on the *Essentials of Method* takes apperception as its foundation-stone. The student should read what is said about the philosophy of the subject, although he may not agree entirely with the practical applications.

Arithmetic.

Simple interest and discount. The first rule presents very little difficulty. Care, however, is required in finding the principal, the time, or the rate per cent. when the amount and other terms are given. Avoid working questions in discount by a mere rule-of-thumb method. The books generally tell you to "find the amount of £100 for the given time at the given rate," but omit to explain the reason; and although the reason is simple, few students trouble to ask themselves for it, and consequently, although they can deal with such mechanical questions as "Find the discount on (or present worth of) so much, due in a certain time, at a given rate per cent.," they are unable to manage questions of a much simpler character which require a knowledge of the fundamental principle. The fact is, if we know the discount on *any sum*, we can find the discount on any other sum under the same conditions by a simple proportion, and we only find the amount of £100, as a general rule, because that is the simplest sum of money of which we know the discount under the given conditions of time and rate. (See this subject in Lock or Christian and Collar.)

English.

First Year.—*Historical grammar of the adverb.* Notice that some are really the oblique cases of Anglo-Saxon nouns: (*a*) genitive, *needs* = of necessity; (*b*) accusative, *home, night and day;* (*c*) dative, *seldom, whilom.* Remember that *-ly* was not originally an adverbial suffix; now it forms adverbs when joined to adjectives—*sweetly.* Those prepositions which with a noun can form adverbial phrases can generally be used alone as adverbs. They must be parsed as adverbs, since their use determines their part of speech. Read again Johnson's *Life of Milton*, and by reference to the works of the latter see whether you think the criticisms are well founded.

Second Year.—Finish the Essays of Leigh Hunt. The one entitled *Memories of the Metropolis* will present some difficulties to provincial students who know nothing of the topography (and we are inclined to think that London students are not, as a rule, so well up in this subject as they might be), but great assistance can be obtained from a good map of London, which should be open while this essay is being read. The last essay, *My Books*, is full of literary allusions. These should be carefully studied with the help of such books of reference as Brewer's *Dictionary of Phrase and Fable*, Chambers's *Cyclopædia of English Literature*, and a good dictionary of biography.

Study carefully *Paradise Lost*, Book I., line 522 to end.

538. *Emblazed.* A term used in heraldry; inscribed with coats of arms.

546. *Orient colours*—lit. *eastern* colours. This may refer to the colours of the sky at sunrise, but more probably to the iridescent colours of pearls, the most beautiful of which came from the East, and were spoken of as "orient pearls."

550. *Phalanx.* The battle array of the Greeks. At first the phalanx consisted of a compact body of men five deep, which depended for success on the weight of the shock of their onslaught. The depth was afterwards increased.

550. *Dorian mode.* For a full account of the Greek modes see the notes on Plato's *Republic* in the October number of The Practical Teacher. The Dorian was the "ray" mode. Plato considered that it had a martial and inspiriting effect.

552–4. Paraphrase thus:—Such as inspired deliberate valour instead of rage, making men firm, and unmoved to flight or disgraceful retreat by fear of death.

561. *Charmed. Charm* is derived from Lat. *carmen*, a song.

Hence it is here used in its literal sense—moved by a song, or affected by music.

573. *Since created man.* Since the creation of man, or since man was created. One of those Latin constructions of which Milton was so fond.

575. *Small infantry.* The Pygmies, a nation of dwarfs warred on by cranes every spring-time. They are described by Homer and other writers. The adventures of Hercules among them suggested Swift's description of Gulliver among the Lilliputians.

578. *That fought at Thebes and Ilium.* The seven heroes who fought against Thebes, and the heroes of the Trojan War. Ilium = Troy.

579. *Auxiliar gods* = auxiliary gods. The poets often described the gods as fighting with men.

580. *Uther's son.* King Arthur, who was king of Britain and Brittany, or Armorica.

583. *Aspramont, Montalban.* Places famous in mediaeval romances.

584. *Damasco, Trebisond.* Places connected with the Crusades.

585. *Or whom.* Or those Saracen warriors who crossed from Africa to Spain and defeated Charlemagne at Fontarabia.

591. *Her.* Milton uses the feminine, probably because the Lat. *forma* is feminine.

598. *Fear of change.* An eclipse was regarded as an omen of evil.

607. *Far other.....bliss.* Who once seemed very different in paradise. *Far* is an adverb of degree.

609. *Amerced.* Deprived; lit. fined. Old Fr. *amercier*, to fine; from Lat. *merces*, reward, deserts.

646. *To work in close design.* To accomplish secretly.

651. *A fame.* A report.

658. *Nor the abyss.....cover.* Neither shall the abyss long cover us with darkness.

659. *Thoughts.* Object of "mature."

670. *Grisly.* Horrible. Not to be confused with *grizzly*, which means greyish.

678. Mammon was the god of wealth of the Syrians. His name was used in St. Luke xvi. 9, and thence passed into modern literature. (See Spenser's *Faëry Queen*, Book II., canto vii.)

688. *Treasures better hid.* Treasures whose discovery has brought misery.

690. *Admire.* Here used in its original sense, "to wonder."

694. *Memphian.* Belonging to Memphis, the ancient capital of Egypt. The reference is to the building of the pyramids.

704. *Bullion dross.* *Dross* = the impurities that rise to the top of molten metal; *bullion* = precious metal, gold not coined.

713–16. Note the architectural terms used:—*Pilasters*, square pillars, or segments of pillars attached to walls. *Doric pillars*, the simplest of the Greek pillars; the capitals consisted of rings. *Architrave* (a hybrid word—*archi*, Gr., chief; *trave*, from *trabem*, a beam), the beam which passes from pillar to pillar and supports the *frieze*, which is surmounted by a *cornice*, a sort of moulding. The three parts—architrave, frieze, cornice—make up the *entablature*, as we call the whole of the part which rests on the pillars.

716. *Bossy sculptures.* High reliefs. Not a very good expression. A boss is a knob or projection.

718. *Alcairo* = Cairo, sometimes called "the grand Cairo."

728. *Cressets.* Lights floating in transparent pots. The word is really a diminutive of "cruse."

729. *Naphtha.* A Greek word. This mineral oil was known to the Greeks, as was *asphalt* or mineral pitch.

739. *Ausonian land* = Italy. *Mulciber*, a surname for Vulcan.

740–5. Note the beauty of these lines.

745. *Zenith.* The point in the heavens directly over the observer's head.

750. *Engines.* Contrivances, devices. *Gin*, a trap, is derived from this.

756. *Pandemonium.* The abode of *all* the *demons*. The word was coined by Milton on the model of the classical Pantheon, the temple of all the gods.

764. *Wont ride.* Were accustomed to ride.

769. *Taurus.* See the notes now being given on astronomy in THE PRACTICAL TEACHER.

785. *Arbitress.* Feminine, because the moon (Luna) is always feminine by personification. An "arbiter" is generally a "judge" or "umpire," but sometimes a "witness."

789. *Incorporeal.* Not consisting of a material body.

795. *Conclave.* A meeting carried on with *locked* doors. (Lat. *clavis*, a key.)

798. *Consult.* Consultation or debate. The scansion requires the accent on the second syllable, but being a noun, the accent should properly come on the first—compare *con'duct* (n.), *conduct'* (v.).

GEOGRAPHY (BOTH YEARS).

Switzerland (continued). The valleys in Switzerland show that the country is watered by three streams—the *Rhone*, in the south, entering Lake Geneva; the *Aar*, a tributary of the Rhine, and itself joined by several streams, connected with Lakes Neuchâtel and Bienne, Brienz and Thun, Lucerne; the *Rhine*, entering Lake Constance, whence it flows west to Basle, forming part of the boundary of Switzerland on the north.

Though Switzerland is well watered, it has no river which is entirely its own. Besides those mentioned, note also the Inn, a tributary of the Danube, flowing through the valley of the Engadine; the Reuss, carrying the waters of Lake Lucerne to the Aar; the Ticino, a tributary of the Italian Po.

Study both rivers and lakes carefully, and mark position on a map.

Note the great influence of elevation on the climate, as well as absence of sea, and existence of narrow mountain valleys: climate varies with altitude—winter reigning all the year above 9,000 feet, while great heat is experienced in some of the narrow valleys.

Switzerland has no mineral wealth; the country is mainly a pastoral one, though manufactures are extensively pursued in the more level parts of the country—that is, in the north and west, where, as the country is deficient in coal, water-power from the strong mountain torrents is employed.

Cattle-rearing is the only profitable agricultural pursuit, cheese and condensed milk being exported in great quantities.

Study the centres for the manufacture of cotton, lace, silk goods, watches, wooden goods. Note also that Switzerland having become "the playground of the world," many of the people are engaged in hotels, acting as guides, etc.

The commerce of the country is great, in spite of many natural drawbacks, and lies mainly with the bordering countries of Germany, France, Austria, Italy. There is also considerable trade, in watches and clocks, wooden toys, and cheese, with the United Kingdom.

Study the means of communication. Roads and railroads are both very good. The Linth Canal is important, not so the rivers; the lakes are much used.

Study with the aid of the map (the maps in a guide-book to Switzerland will be found most useful; some of the free libraries contain guide-books) the position of the various cantons, with their chief towns, and note the manufacturing areas specially.

Note, also, that the population is not gathered in a few large towns, but in villages, hamlets, and small towns.

Mark in a map the position of the Principality of Liechtenstein, with its capital Vaduz. It lies on the right bank of the Rhine, above the entrance of the river into Lake Constance; it is independent, but under the control and protection of Austria.

Austria-Hungary, the second largest country in Europe, is a dual empire, consisting of Austrian or Cis-Leithan Provinces (note river Leitha, which joins Danube a few miles east of Vienna), and Hungarian or Trans-Leithan Provinces. Each of the two divisions has its own parliament, administration, etc., but both are under one sovereign, the Emperor of Austria being also King of Hungary. Learn the position and boundaries from a map: observe the short coast-line, on the Adriatic, with the ports Trieste and Fiume; but note that the Danube, a great commercial river, partly compensates for the want of coast-line. Consider the effect on the commerce of the country of the absence of ports and the extensive land borders.

Bosnia and Herzegovina, in the north-west of the Balkan Peninsula, are practically parts of the Austro-Hungarian Empire. Liechtenstein, in Switzerland, is also under the protection of the empire.

In studying the "build" of the country, note the following features, using a sketch-map, and marking in chief points:—

1. The mountains, including the *Bohemian System*, enclosing the table-land of Bohemia (see notes on mountains of Germany); the *Alpine System*, in the Tyrol and south-west; the *Carpathian System*, extending in a great curve from Pressburg, on the Danube, to the Iron Gate.

2. The plain of Hungary, watered by the Middle Danube. Study character of surface, products, etc.

3. The plateau of Bohemia.

The country is generally suited for agriculture, the only wastes being the marshes near the rivers, and the district near Trieste called Karst. Study rivers and lakes, noting great commercial importance of Danube and its tributaries.

The *climate*, like the build of the country, exhibits great variety; the country, except that part south of the Alps lying along the Adriatic, has a more or less continental climate. The rainfall in the Alpine districts is great; that in the plains low, though sufficient for agricultural purposes.

The products are important and very varied. The mineral wealth is great, though not as well developed as in England or Germany.

Agriculture is the chief occupation of the people, especially in Hungary and Galicia; *mining* is important; *manufactures* are on the increase in the Austrian provinces. Learn chief centres of cotton, woollen, linen, and glass trades.

History.

Both Years.—Make a careful study of the American War of Independence. Remember that the repeal of the Stamp Act was accompanied by a declaration that Great Britain had the right to tax her colonies—a declaration which kept alive the ill-feeling caused by the Stamp Act. In 1767 Townshend imposed fresh taxes, the produce to be devoted to paying the judges and governors. The taxed articles were boycotted, and the collectors treated with violence. Lord North induced Parliament to repeal all colonial taxes except that of threepence a pound on tea. He wished to keep this, to assert the claim of England to tax the colonies; the colonies determined not to pay. Boston tea ships, 1773. Congress of Philadelphia attended by representatives of all the states except Georgia, 1774. Armed rising of the colonists after the affair at Lexington, 1775. Outbreak and course of the war. The engagement which had most effect in deciding the issue of the war was the Battle of Saratoga. The student should read the account of this in Creasy's *Fifteen Decisive Battles of the World*, which throws a clear light on the points at issue in the war, and on the way in which the war was carried on, as well as on the effect of this particular engagement in deciding the result, although the capitulation of Yorktown was the crowning event.

Follow out the influence of our Continental relations on this struggle. Particularly note the effect of the French naval supremacy prior to Lord Rodney's victory in the West Indies, and the failure of the combined attack of the French and Spaniards on Gibraltar.

Treaty of Paris, 1783.—1. Independence of United States recognised. 2. Minorca restored to Spain. 3. Dunkirk allowed to be fortified (see treaty of Utrecht). 4. Some of the West Indian islands changed ownership.

Algebra.

Women—Both Years.—Treatment of fractions in algebra. The best plan is to factorise all the numerators and denominators, and not multiply anything out till the end; this will give opportunities for cancelling.

Men—First Year.—General exercises in quadratic equations, including problems. Many equations of a degree higher than the second can be solved in the same manner as quadratics, if we work in two steps. Thus the equation

$$(x^2 - 4x)^2 + 8x^2 - 32x + 16 = 0$$

may be written

$$(x^2 - 4x)^2 + 8(x^2 - 4x) + 16 = 0.$$

Regarding the expression in the brackets $(x^2 - 4x)$ as the unknown quantity, we may first find its value—

$$\{(x^2 - 4x) + 4\}\{(x^2 - 4x) + 4\} = 0.$$

$$\therefore (x^2 - 4x) + 4 = 0.$$

That is, $(x - 2)^2 = 0$. $\therefore x = 2$.

The four roots are identical.

Men—Second Year.—*Interest.* Simple interest presents no features in algebra which are not found in arithmetic. Compound interest for a long period is found much more readily by the use of logarithms. In the ordinary arithmetical calculation, the amount of work to be done increases with the time the money is out at interest; but this is not the case in algebra. If R denotes the rate per cent. per annum, then $\frac{R}{100}$ is the interest on £1 for one year—that is, each pound in one year amounts to $£\left(1 + \frac{R}{100}\right)$; consequently, P pounds will amount to $P\left(1 + \frac{R}{100}\right)$ pounds. In the second year each of these pounds will amount to $\left(1 + \frac{R}{100}\right)$; consequently, the whole amount of P at the end of two years will be $P\left(1 + \frac{R}{100}\right)\left(1 + \frac{R}{100}\right)$—that is, $P\left(1 + \frac{R}{100}\right)^2$. Continuing the reasoning, we obtain the general formula for the amount at the end of n years, $A = P\left(1 + \frac{R}{100}\right)^n$.

Find the amount of £700 at the end of 16 years at 5 per cent.

$$A = 700(1{\cdot}05)^{16}.$$

$$\therefore \log A = \log 7 + 2 + 16 \times (\log 105 - 2),$$

$$\log A = {\cdot}8450980 + 2 + 16(2{\cdot}0211893 - 2)$$

$$= {\cdot}8450980 + 2 + {\cdot}3390288$$

$$= 3{\cdot}1841268.$$

In the tables we find log 15280 = 1841234, and log 15281 = 1841518.

$$\therefore 3{\cdot}1841268 = \log 1528{\cdot}012.$$

Ans. £1528, 0s. 3d.

If a sum of money is not payable till the end of a number of years, compound interest must be reckoned in calculating discount for present payment. Remembering the relations between the terms used in discount and those used in interest, we can obtain the formula for discount from the one for interest—namely, $A = P\left(1 + \frac{R}{100}\right)^n$, for P is the present worth of A.

Hence $P = A \div \left(1 + \frac{R}{100}\right)^n = \frac{A \times 100^n}{(100 + R)^n}$; or if we use r to denote the interest on £1 instead of the fraction $\frac{R}{100}$, the formula becomes $P = A \div (1 + r)^n$ or $\frac{A}{(1 + r)^n}$, and the difference between the amount and the present worth gives us the discount.

If this is clearly understood, problems in annuities will present no difficulty, especially if approached by the following steps:—

1. To find the sum of the amounts paid as an annuity and put out at interest as soon as paid. This will be the sum of the geometrical series—

$$A + A(1 + r) + A(1 + r)^2 \ldots = \frac{A\{(1 + r)^n - 1\}}{1 + r - 1}.$$

2. Knowing what the yearly payments would total up to (at interest) at the end of the last year of payment, we can easily find the present value of this amount by the preceding work.

3. A perpetual annuity gives us an infinite geometric series which has a present value $\frac{A}{r}$. This value is evidently that sum whose yearly interest is equal to the annuity.

Euclid.

Women—First Year.—Revise to end of Prop. 26, and work exercises.

Women—Second Year.—Finish Book II. Prop. 11 is easy if only you *start* the proof on the right lines—that is, by Prop. 6. The student sometimes finds a difficulty in grasping the inclusion of the two cases of Prop. 13 in one proof; but it is not difficult if she remembers that Prop. 7 refers to the "squares on the whole line and on one of the parts." And it does not signify which of the two (BC, CD) is the whole and which the part; we deal with the squares on both.

Men—First Year.—Revise Book I., with deductions.

Men—Second Year.—To end of VI. 13, with exercises.

Latin.

See Practical Teacher Matriculation Course.

French.

First Year.—Adverbs: their formation and use. Remember why the suffix *-ment* is added to the *feminine* of adjectives. This suffix was originally the Latin feminine noun *mens, mentis*, the mind: people said originally *jocosa mente*, with a joyous mind; hence the compound *joyeusement*.

Le Voyage, chaps. i.–xii., translation and retranslation.

Second Year.—Prepositions and conjunctions.

Le Roi des Montagnes, Practical Teacher edition, pp. 117-132 (line 2), translation and retranslation. Exercise 16.

Answers to Correspondents.

P. B.—Any of the geographies mentioned in our list in July last. Pay special attention to the historical aspect of the subject.

R. J. C. (Wrexham).—You are strongly advised to work algebra during the first year, in order to take the paper in it at the second year examination.

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LONDON MATRICULATION.

JUNE 1900.

BY R. C. B. KERIN, B.A. (LOND.),
First in First Class Classical Honours at Final.

LATIN COURSE FOR MARCH.

1. Cæsar.—Revise chaps. XX. to XXX. of Book IV.

2. Grammar.—Learn the verbs of the third conjugation that are irregular in the perfect and supine. In the syntax, note how questions are asked in Latin; the rules for the sequence of the tenses of the subjunctive; the difference in the uses of the tenses of the indicative in Latin and English; the uses of the negatives. Revise the uses of the cases and the declensions again. The nouns of the third declension especially should be learned again and again, monotonous though the task may be.

3. *Anglice Reddenda*, Nos. 60–70.

4. Sentences from Bradley's *Arnold* or Bayfield's or Allen's *Exercise Book*.

Notes on Grammar.

Know the different usages of *haud*, *non*, and *ne* to express "not." *Ne* is used in wishes and prohibitions; *haud* is normally used before adjectives and adverbs. Note, however, the use of *haud* with a verb in the phrase *haud scio an*, "I am inclined to think." The various interrogative particles used in asking questions are important. Distinguish the different methods of translating "whether.....or." In a question use *utrum.....an*. Remember that "whether.....or" in an adverbial clause is translated by *sive.....sive*. In some cases it is hard to tell whether the clauses are adverbial or not. The best test is this: if you can take away the "whether.....or" clause and leave the sense complete, then the "whether.....or" clause is adverbial. If, however, the absence of the clause would leave the sense incomplete, then the clause is an interrogative one. Note the differences between *num*, *ne*, and *nonne* in asking questions.

Remember that *an* is not used in the first portion of disjunctive questions. Where *an* apparently is used in this way, there is always an ellipsis of the first alternative. Postgate notices some cases in which the tense of the indicative in Latin differs from the tense in English. *Postquam* is followed by the perfect indicative, instead of the pluperfect, if the exact time after is not mentioned—for example, "After he had said this, we went away," *Postquam hoc dixit, abivimus*. Again, after the words *si*, *cum*, *donec* (until), etc., when the principal verb is in a future tense, the future simple is used in Latin, when the time of the actions expressed by the principal sentence and the dependent sentence is the same—for example, *hoc faciam cum potero*—we say, "I shall do this when I can." *Hoc faciam cum possum* would be bad Latin. If, however, the action of the dependent clause is antecedent to that of the principal clause, use the future perfect indicative in the dependent clause—for example, *non respondebo donec tacueris*, "I shall not answer till you are silent." Here the silence begins before the answer is made, and as the verb of answering is in the future, the verb of silence will be in the future perfect. The rule for the sequence of tenses must be thoroughly known and applied. I need not lay stress on the fact that knowing a rule is one thing and applying it another. There is perhaps no rule which is so often disregarded, even by men who have been a considerable time at Latin. I have often alluded to it in the sentences; I shall, however, sum it up again. This rule regulates the tenses of the subjunctive to be used in dependent clauses. If the verb in the principal clause is in a secondary or historical sense—that is, the imperfect, pluperfect, aorist perfect—the imperfect or pluperfect subjunctive is to be used. If the principal verb is in a primary tense—that is, present, future, future perfect, present perfect, and imperative—use either the present or perfect subjunctive. The historical present will be followed by either primary or secondary sequence. For fuller details see the sentences previously given.

Typical Sentences.

23. "They were so pleased with their lot that they never repented of having left that beautiful city of Syracuse."

Sorte sua tam contenti erant ut nunquam se poeniteret Syracusis ab illa urbe pulcherrima abivisse.

Notes.—(*a*) "So" before an adjective or adverb is *tam*; before verbs, *sic*, *ita*, or *adeo*. (*b*) *Contentus* is followed by the ablative. (*c*) "That," in consecutive and final clauses, is expressed by *ut*. Note, however, when there is a negative in the clause, that *ut non* is used in consecutive clauses, and *ne* in negative final clauses. (*d*) *Poenitet* is used impersonally, and takes accusative of the person and gender of the thing. If, however, in English you have a verbal noun, as in the sentence above, use *not* the gerund, but the infinitive or a *quod* clause. (*e*) Note that when you have in English "from the city of Syracuse," you say *ex urbe Syracusis*; when you have an adjective attached to the word "city," you put the name of the city first in the required case, and then the preposition *ab* or *ex* with the adjective and *urbe*.

24. "There are few who would marry her, but there are many who would marry him."

Pauci sunt qui illam in matrimonium ducant, sed multae sunt qui illi nubant.

Notes.—(*a*) When a relative has an indefinite antecedent, the subjunctive is used in the relative clause. This use of *qui* is called *generic*. The subjunctive is known as the *generic* or descriptive subjunctive. (*b*) "To marry" (of a man), *in matrimonium ducere* (the wife was escorted to her husband's home); "to marry" (of a woman) is *nubo*, which governs the dative.

25. "I do not know if he has been accused of murdering his friend."

Nescio num accusatus sit quod amicum suum occiderit.

Notes.—(*a*) "Of" and a verbal noun, when depending on a verb, are never expressed by the genitive of the gerund in Latin. The general way, then, of expressing "of" and the verbal is by using *quod* (because) and a finite verb. The subjunctive will be used with *quod* if the reason given is the opinion of some one other than the speaker or writer. Consequently, in the sentence above we use *quod* and the subjunctive, as the reason given is evidently that of the people who brought the accusation (literally, "He was accused because, as they said, he had murdered his friend"). This subjunctive is called the subjunctive of *sub-oblique narration*. (*b*) "If," in a question, is not expressed by *si*, but by *num*. (*c*) *Accusatus sit* is subjunctive in a dependent question. (*d*) *Nescio* is used instead of *non scio*. Avoid using *novi*, which is used of knowing a person.

Sentences for Practice.

(Readers can have their solutions corrected by sending them to the Editor Matriculation Course *P. T.*, and enclosing seven stamps.)

1. There are some who say that he was weary of life; others say that he never repented of his crimes.

2. I do not know if he went to the city of Rome from the beautiful city of Corinth.

3. He would have married his servant, if his friends had not prevented him.

4. If you are so pleased with your lot, I am glad.

5. It is said that he does not know how much three times four is.

6. Some one accused him of betraying the city, and he was condemned by all the judges.

7. If you accused him to-morrow of killing his father, he would not be acquitted (*absolvo*).

8. No one knows who did this crime, nor even when it was committed.

9. So far is he from praising him, that he has refused to help him in any way. (Use *tantum abesse ut.....ut.*)

CÆSAR—Book IV., XXXII. TO XXXVIII.

Notes.

Chap. xxxii.

Dum geruntur—note use of *dum*, "while," with the present indicative. In English we use a past tense.

suspicione interposita—ablative absolute. Note *neque ulla*, instead of *et nulla*, as the beginner generally writes.

remaneret—subjunctive, due to *cum*, causal.

ferret and *fecisset*—subjunctives in *oratio obliqua*.

novi consilii—partitive genitive depending on *aliquid*.

in stationem succedere—"to relieve guard."

cum.....processisset—"after advancing." Note this translation of *cum* and the pluperfect subjunctive by "after" and a verbal noun in English.

huc—distinguish *hic*, "here," denoting rest, from *huc*, "here," denoting motion to.

Chap. xxxiii.

primo—"at first;" *primum*, "first of all."

pedibus—"on foot." Be careful not to translate "on foot" by *pede*.

praestare—"display" or "show" governs the accusative. If it means "to surpass," it governs the dative of the person and the ablative of the thing surpassed. It is also used impersonally (= "it is better"), and then requires the infinitive.

brevi—"in a short time;" *breviter*, "briefly."

consuerint = *consueverint*.

Chap. xxxiv.

quibus rebus—ablative of instrument with *perturbatis; perturbatis nostris* in the dative, governed by *tulit auxilium.*
noritate—ablative of cause, "on account of the strangeness."
ad committendum proelium—instance of *ad* with the accusative of the *gerundive* (not *gerund*) to express purpose.
dies—accusative of duration of time.
quae—"consecutive," "of such a kind that they kept" = *ut eae.*
daretur—subjunctive in a dependent question-sentence introduced by the interrogative word *quanta.*
sui liberandi = *se liberandi*—an instance of gerundival attraction.
expulissent—subjunctive of *oratio obliqua.*

Chap. xxxv.

idem quod—"the same as."
diebus—ablative of point of time.
ut—explanatory; *ut* with subjunctive = "namely that."
secum—remember to write *mecum, tecum, secum, nobiscum, vobiscum,* not *cum me,* etc.
tanto spatio—ablative of place, "within which" (literally, "within so much space").

Chap. xxxvi.

legatus—in Cæsar means either (*a*) ambassador (as here) or (*b*) lieutenant.
imperaverat—governs here the accusative of the thing requisitioned, and is a transitive verb.
his—dative of disadvantage; literally, "for them."
infirmis navibus—either ablative of attendant circumstances, or dative with the gerundive *subiiciendam* (*subiiciendam esse,* infinitive depending on *existimabat*).
navigationem hiemi subiicere—"to expose a voyage to winter"—that is, "to run the risk of sailing in winter" (Bryans).
tempestatem—a colourless word in Latin, not always = "bad weather."
quae omnes—we say "all of which;" *omnes quarum* would be bad Latin. (See Notes on Sentences.)
solvit (sc. *ancoram*)—"weighs anchor."
quos reliqui (sc. *ceperunt*).
delatae—"came to land."

Chap. xxxvii.

expositi—"disembarked."
Britanniam—requires a preposition, as it was not regarded as a small island.
nollent—subjunctive in *oratio obliqua.* The sentence forms part of the orders given.
orbem facere—form a "platoon" or "square."
auxilio—dative of purpose, very common with *mitto.*
horis quattuor—ablative of comparison after *amplius* without *quam* inserted, though after *plus, amplius,* and *minus* the *quam* may be omitted, and the following word kept in its original case.
paucis volneribus acceptis—"with few casualties;" ablative absolute.
postea quam—to be taken together = *postquam,* followed by the perfect indicative, where we would use the pluperfect—"after the cavalry had come in sight."

Chap. xxxviii.

reciperent—subjunctive, for two reasons—(*a*) because it is deliberative, "where they were to go to;" (*b*) because it is in a dependent question introduced by the interrogative *quo.* In English we often use the infinitive in translating such deliberative expressions as this, "they had no place to go to."
eo—"there," when it means "thither."
supplicatio—"thanksgiving."

Test Paper.

(Readers can have their papers corrected by enclosing seven stamps.)

1. To what parts of speech do the supines properly belong? Explain, with examples, how they are used.

2. Distinguish between a gerund and gerundive. What supplies the nominative case of the gerund? Give examples of the various uses of the gerund.

3. Point out the ambiguity of *victoribus victis parcendum.* How can it be avoided?

4. Distinguish between *mŏra* and *mōra; foras, forum, fores, foros; lĕgo* and *lēgo; questus* and *quaestus; pătĕre* and *pātēre; auri, auris, aura; ŏrā* (2) and *ōrā; ăvia* and *āvia; veri* (2) and *vīre.*

5. Write down the third singular of all tenses of *adeo, volo, ĕo, ēdo, affero.*

6. Translate, remarking on the construction of the words in italics:—(1) *Quanti* emptum est? *Parvo.* (2) Caesar *hos frumentum* quod *polliciti essent* flagitabat. (What would be the difference if *polliciti erant* were used?) (3) Suo *cuique* iudicio *utendum est.* (4) Suos *hortatur* ut fortem animum *gererent.*

7. Which compounds of *caedo* have a supine, and what is their supine? What is the perfect of compounds of *cano?*

QUERY COLUMN.

RULES.

1. Each correspondent is restricted to *one* question.
2. Each query must be accompanied by the name and address of the correspondent, and the *coupon* which appears on the back wrapper of the current number of the Journal.
3. CORRESPONDENTS MUST IN ALL CASES STATE THE SOURCE FROM WHICH THEIR QUERY HAS BEEN OBTAINED.

The Editor reserves to himself the right to decline to answer any question which is, in his judgment, unsuited to the Magazine.

—— (postmark Chester).—Please see Rules 2 and 3.

Discipulus (Straits Settlements).—You can obtain translation in Messrs. G. Bell and Sons' cheap edition of Bohn's Series; Fawcett's *Political Economy* (Macmillan); *Latin Grammar* (Oxford University Press); *Geometrical Conics,* Macaulay (Cambridge Press).

Bike.—AB is the diameter of a circle whose centre is C. In AB produced, take D and E such that DF and EG being drawn to touch the circle at F and G, EG may equal nDF; let F and G be on the same side of AB, and join CF, CG. Show that the angle FCG will be greatest when DF equals (radius) $\div \sqrt{n}$.
(Honours, Part I., May 1898.)

Denoting the angles DCF and ECG by θ and ϕ,

$$\tan\theta = \frac{DF}{r},\ \tan\phi = \frac{EG}{r}.\quad \therefore \tan\phi = n\tan\theta;$$

$$\tan FCG = \tan(\phi - \theta) = \frac{\tan\phi - \tan\theta}{1 + \tan\phi \,.\, \tan\theta} = \frac{(n-1)\tan\theta}{1 + n\tan^2\theta}.$$

Put x for $\tan\theta$, omit the constant $n - 1$, and write—

$$y = \frac{x}{1 + nx^2}.$$

Since y has to be a maximum, solve for x;

then $$x = \frac{1}{2ny} \pm \frac{\sqrt{1 - 4ny^2}}{2ny}.$$

As x is real, $1 - 4ny^2$ *must not be negative,* therefore y cannot be greater than $\frac{1}{2\sqrt{n}}$; and when it has this maximum value, $x = \frac{1}{2ny} = \frac{1}{\sqrt{n}}$.

Hence when $\tan\theta = \frac{1}{\sqrt{n}}$—that is, $\frac{DF}{r} = \frac{1}{\sqrt{n}}$—FCG will be a maximum.

——. What distance in space is travelled in an hour, in consequence of the earth's rotation, by a person situated in latitude 60°? (Earth's radius = 4,000 miles.) (Lock, p. 65.)

For solution, see Query Column in THE PRACTICAL TEACHER for February.

——. The length of the shadow of a vertical stick is to the length of the stick as $\sqrt{3} : 1$. If the stick be turned about its lower end in a vertical plane, so that the shadow is always in the same direction, find what would be the inclination to the horizon when the length of the shadow is the same as before.
(Lock, p. 63.)

You may easily draw a figure to suit the following.

Let AB be the vertical stick, B being the lower end. Draw BC horizontally, and $\sqrt{3}$ times BA; then the angle CAB is 60°. Now take A^1 in CA such that $BA^1 = BA$: then BA^1 is the second position of stick. Clearly the angles BA^1A, BAA^1 are equal, and each is 60°; hence A^1BA is 60°, and CBA^1, the required inclination, is 30°.

Ignoratio.—Complete the annexed multiplication sum by replacing the dots by digits.

$$\begin{array}{r} 4\,.\,. \\ \times\quad 5\,. \\ \hline 36\,.\,. \\ .\,.\,6\,. \\ \hline .\,.\,2\,.\,. \end{array}$$

(Christian and Collar, p. 220.)

Let a, b stand for the tens and units digits in the multiplicand, and c for the unknown digit in the multiplier; then we observe that—

1. c cannot be less than 8, otherwise the 36 could not be obtained; hence c must be 8 or 9.

2. Suppose c is 9, then neither a nor b can be greater than 1, otherwise the 36 could not be obtained. But if neither a nor b be greater than 1, we cannot possibly obtain the 6 in the second partial product. Hence c cannot be 9, therefore it is 8.

3. Since $8 \times 4 = 32$, there must be 4 (and 4 only) to carry after multiplying a by 8; hence a is 5 or 6 (try $a = 4$ or 7).

4. a cannot be 6, for whatever b were, we could not then obtain the 6 in the second partial product; hence a is 5.

5. Since a is 5, b must be 2 or 3, for no other number could give rise to the 6 in the second partial product.

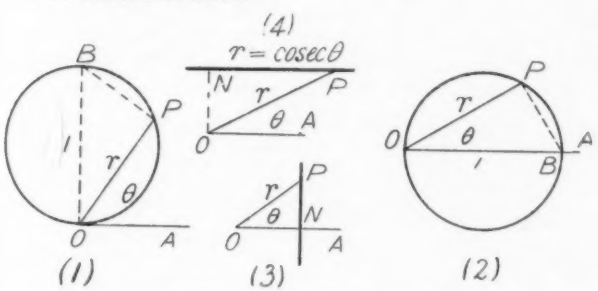
The multiplier is 58, and the multiplicand 452 or 453.

Ralpo.—What curves are represented by the equations

$r = \sin\theta$; $r = \cos\theta$; $r = \sec\theta$; $r = \operatorname{cosec}\theta$?

(St. Andrews M.A., 1895.)

(1) and (2) are the circles shown in the figure; (3) and (4) are the lines there shown.



In every case O is the pole, and OA the initial line.

In (1), if OB = 1, clearly, wherever P may be on the circle, it is true that OP = OB sin θ—that is, $r = \sin\theta$.

Similarly in (2), OP = OB cos θ—that is, $r = \cos\theta$.

In (3), so long as P is on the vertical line, ON = OP cos θ; and if we make ON = 1, then $1 = r\cos\theta$, or $r = \sec\theta$.

Similarly in (4), ON = OP sin θ, hence $1 = r\sin\theta$, or $r = \operatorname{cosec}\theta$.

M.A.—Simplify

$$\frac{(a+b)^7 - a^7 - b^7}{(a+b)^5 - a^5 - b^5}.$$

(St. Andrews M.A., 1898.)

Expanding $(a+b)^7$ and $(a+b)^5$ by the binomial theorem, the fraction becomes—

$$\frac{7a^6b + 21a^5b^2 + 35a^4b^3 + 35a^3b^4 + 21a^2b^5 + 7ab^6}{5a^4b + 10a^3b^2 + 10a^2b^3 + 5ab^4}$$

$$= \frac{7ab(a^5 + b^5) + 21a^2b^2(a^3 + b^3) + 35a^3b^3(a+b)}{5ab(a^3 + b^3) + 10a^2b^2(a+b)}.$$

Dividing every term by $ab(a+b)$, we obtain—

$$\frac{7(a^4 - a^3b + a^2b^2 - ab^3 + b^4) + 21ab(a^2 - ab + b^2) + 35a^2b^2}{5(a^2 - ab + b^2) + 10ab}$$

$$= \frac{7a^4 + 14a^3b + 21a^2b^2 + 14ab^3 + 7b^4}{5(a^2 + ab + b^2)}$$

$$= \frac{7(a^4 + b^4) + 14ab(a^2 + b^2) + 21a^2b^2}{5(a^2 + ab + b^2)}$$

$$= \frac{7[(a^4 + b^4 + 2a^2b^2) + 2ab(a^2 + b^2) + a^2b^2]}{5[a^2 + 2ab + b^2 - ab]}$$

$$= \frac{7[(a^2 + b^2)^2 + 2ab(a^2 + b^2) + a^2b^2]}{5[(a+b)^2 - ab]}$$

$$= \frac{7}{5} \cdot \frac{(a^2 + b^2 + ab)^2}{(a+b)^2 - ab}.$$

Discipulus.—Show that

$$\frac{1 + \frac{1}{4} + \frac{1.3}{4.8} + \frac{1.3.5}{4.8.12} + \ldots}{1 - \frac{1}{4} + \frac{1.3}{4.8} - \frac{1.3.5}{4.8.12}} = 1 + \frac{1}{3} + \frac{1.3}{3.6} + \frac{1.3.5}{3.6.9} + \ldots$$

(Cambridge Senior Local, 1899.)

It is impossible to work this kind of example unless you are familiar with the form of the coefficients in certain binomial expansions. For example, you must have noticed in the expansion of $(1 \pm x)^{-\frac{1}{2}}$ that the odd numbers 1 . 3, 1 . 3 . 5, etc., occur in the coefficients. Thus, when simplified,

$$(1-x)^{-\frac{1}{2}} = 1 + \frac{1}{2}x + \frac{1.3}{1.2}\frac{1}{2^2}x^2 + \frac{1.3.5}{1.2.3}\frac{1}{2^3}x^3 + \ldots$$

Hence you are expected to *observe* that the given fraction on the left hand is

$$\frac{\left(1 - \frac{1}{2}\right)^{-\frac{1}{2}}}{\left(1 + \frac{1}{2}\right)^{-\frac{1}{2}}}, \text{ or } \left(\frac{1}{3}\right)^{-\frac{1}{2}}; \text{ that is, } \left(1 - \frac{2}{3}\right)^{-\frac{1}{2}}.$$

The result, $\left(1 - \frac{2}{3}\right)^{-\frac{1}{2}}$, suggests that the right hand is also $\left(1 - \frac{2}{3}\right)^{-\frac{1}{2}}$, which you find to be the case on expanding $\left(1 - \frac{2}{3}\right)^{-\frac{1}{2}}$.

N.B.—Please note Rules 1 and 2.

For No. 12, see Hall and Knight's *Higher Algebra*, Art. 421.

For No. 4, see recent numbers of THE PRACTICAL TEACHER, Query Column.

No. 5 consists of two simple G.P's.

Puzzled.—Prove that

$$\frac{a^2}{rr_a} = \frac{(r_b + r_c)^2}{r_b r_c}.$$

$$\frac{(r_b + r_c)^2}{r_b r_c} = \frac{r_b^2 + 2r_b r_c + r_c^2}{r_b r_c} = \frac{r_b}{r_c} + 2 + \frac{r_c}{r_b}$$

$$= \left(\frac{S}{s-b} \div \frac{S}{s-c}\right) + 2 + \left(\frac{S}{s-c} \div \frac{S}{s-b}\right)$$

$$= \frac{s-c}{s-b} + 2 + \frac{s-b}{s-c}$$

$$= \{(s-c)^2 + 2(s-b)(s-c) + (s-b)^2\} \div (s-b)(s-c)$$

$$= (s - c + s - b)^2 \div (s-b)(s-c)$$

$$= a^2 \div (s-b)(s-c).$$

$$\frac{a^2}{rr_a} = a^2 \div \frac{S}{s} \cdot \frac{S}{s-a} = a^2 \div \frac{S^2}{s(s-a)}$$

$$= \frac{a^2 s(s-a)}{S^2} = \frac{a^2 s(s-a)}{s(s-a)(s-b)(s-c)}$$

$$= a^2 \div (s-b)(s-c). \quad Q.E.D.$$

Timothy.—Show that $\sin^{-1}\frac{4}{5} + \sin^{-1}\frac{5}{13} + \sin^{-1}\frac{16}{65} = \frac{\pi}{2}$.

(H. Smith's *Trigonometry.*)

Let $\sin^{-1}\frac{4}{5} = A$; $\sin^{-1}\frac{5}{13} = B$; $\sin^{-1}\frac{16}{65} = C$.

Then $\sin A = \frac{4}{5}$; $\sin B = \frac{5}{13}$; $\sin C = \frac{16}{65}$;

$$\sin(A+B) = \sin A \cos B + \cos A \sin B$$

$$= \frac{4}{5} \cdot \frac{12}{13} + \frac{3}{5} \cdot \frac{5}{13} = \frac{63}{65};$$

$$\sin\{(A+B) + C\} = \sin(A+B) \cdot \cos C + \cos(A+B) \cdot \sin C$$

$$= \frac{63}{65} \cdot \frac{63}{65} + \frac{16}{65} \cdot \frac{16}{65}$$

$$= \frac{63^2 + 16^2}{65^2} = 1.$$

$\therefore A + B + C = 90°$, or $450°$, or $810°$, etc.

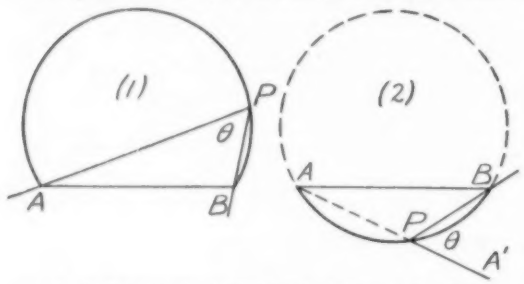
N.B.—See Rule 1.

J.S.B.—Yes, the pamphlet has been issued. You can also obtain from the Secretary of the Department of Science and Art the report on *Practical Mathematics*, containing the solutions to all the questions in the last examination. We believe that both the pamphlet and the report can be had *gratis*, or at any rate for a nominal sum.

Nemo.—If two straight lines, fixed relatively to each other, intersect in the point P, and if they move in such a way that each always passes through a fixed point, show that the *locus* of P is a circle. Explain how the motion must take place if P is to describe the whole circumference. (Stage 2, 1880.)

By III. 21, if A and B are two *fixed* points on the circumference of a circle, and P is *any* other point on the circumference, then the angle APB is of the same magnitude wherever P may be, so long as it is on the circumference and on the same side of AB.

Hence, conversely, in this rider, if A and B (Fig. 1) are *fixed* points, and PA, PB are movable lines such that the



angle APB is constant (that is, the lines are fixed relatively to each other), then if P moves, its path or *locus*, is the segment of the circle shown *above* AB.

If the segment below AB (Fig. 2) has to be described by P, then the motion must take place so that one line, PB, passes through one fixed point B, while the other line, A'P, *produced*, passes through the other fixed point A.

Spes Bona.—The uniform daily cost of dining alone is the same for each one of three men; but if two of three or three of three dine together, the cost is diminished at the rate of 4 per cent., or 11⅓ per cent. for each man. A certain sum will pay the cost, either of three dining together for a certain time, or of two dining together for a week longer. For how many days will it pay the cost of one dining alone? (College of Preceptors.)

The *cost* of 3 men for any time : *cost* of 2 men for the same time :: $3 \times 88\frac{2}{3} : 2 \times 96$.

,, : ,, :: 25 : 18.

(It would be 3 : 2 if there were no reduction, but with a reduction of 11⅓ per cent. in the case of 3 men, and 4 per cent. in the case of 2 men, the ratio is *less than* 3 : 2.)

∴ the *time* which a certain sum will keep 3 men : the *time* which this sum will keep 2 men :: 18 : 25.

But since the second time happens to be 7 days more than the first, the two times are not merely in the *ratio* of 18 to 25, but they are actually 18 days and 25 days.

Again, if there were no reduction, the time which this sum would keep one man would be 25×2; but as it is cheaper for each of two men, the answer will be less than 50 by 4 per cent.—that is, it will be $\frac{96}{100}$ of 50, or *48 days*.

M. B.—The coach fare between two places is 5s., and each passenger is allowed 56 lbs. of luggage free, excess luggage being paid for at a certain rate per lb. Two travellers, A and B, have more than 112 lbs. of luggage between them, but A has less than 56 lbs. If A alone had travelled, and taken with him the luggage of both, the coach proprietor would have received the same amount as he does when they both travel independently. If, however, they had divided their luggage equally between them, the proprietor would have received 2s. less. How much luggage had A? (Cambridge Local Junior, 1897.)

When A travels alone, the total excess luggage consists of the *whole* of A's *plus* B's excess. The charge for this, together with one fare of 60 pence, *is the same as* the charge for B's excess together with two fares of 120 pence; hence A's luggage, when the whole of it is charged as excess, costs 60 pence.

Now in the last case, B, from his excess luggage, first hands over to A an amount just enough to bring A's up to 56 lbs. This is the portion which is not charged as excess in the third case, but was in the second; hence this portion must have cost 24 pence before. Therefore if A's luggage costs 60 pence (if it were all excess), and the amount required to make up 56 lbs. costs 24 pence, then 56 lbs. must cost 60 + 24, or 84 pence, or 1½ pence per lb. Hence A's luggage weighs 60 ÷ 1½, or 40 lbs.

SCIENCE NOTES.

The Phenomena of Ascending Sap.—H. W. Chamberlain has recently been investigating the phenomena connected with the ascending sap of plants. A long course of experiments has led him to the following conclusions:—After decapitation, an efflux of water occurs in some plants, but not in others; root-pressure is stronger in herbaceous plants than in woody plants; when the plant is in active growth, the season of the year has no little influence on the root-pressure. He arranges the plants he examined in three groups in respect to a daily periodicity. In the first group no trace was seen of any daily periodicity in the flow of sap. In the second group, while a daily periodicity occurred, the times for the maxima and minima were uncertain. In the third group the periodicity was regular and permanent. Chamberlain is of opinion that variations in temperature have no marked influence on the root-pressure; that the ascent of sap is greatly promoted by moistening the leaves, while saturation of the soil acts prejudicially in this direction; and that the larger and more strongly developed the roots are, the stronger is the root-pressure.

The Sterilisation of Drinking Water.—Ozone has been lately used to sterilise water for drinking purposes. Water from the Spree, in some experiments by Weyl, was pumped through a chamber filled with stones, by which the suspended matter was strained off. Then by means of another centrifugal pump the water was pumped into a second cylindrical chamber, 4·5 metres in height, and filled with large stones, through which the water trickled, and so became finely divided, meeting the stream of ozonised air introduced below. The ozonised water collected in the lower part of this chamber, and thence passed to the reservoir. Eight hundred gallons of water per hour were thus treated. The experiments showed that in the case of a good water 1 gramme of ozone per cubic metre (200 gallons) was sufficient, but for a bad water 2 grammes were required for sterilisation, the cost being about one-third of a penny per gramme of ozone. The whole machinery was driven by electricity.

Algeria and the Cultivation of Insect-Flowers.—Some interesting experiments have recently been made at the botanical station of Rouiba in Algeria. Trial cultivations were undertaken with the white pyrethrum of Dalmatia, which furnishes two-thirds of the insect-powder (from pyrethrum flowers) that is used in Europe. The Dalmatian plant is more vigorous and more prolific in flowers than the Caucasian and Persian varieties. It requires a clayey soil, somewhat light, for it can resist drought. In Algeria the plant is sown in the nursery in the beginning of autumn, and transplanted in the spring. The plantation is arranged in rows one metre apart, and each plant is separated from the next by a distance of fifty centimetres. The plant flowers in May, and the harvest takes place during the summer. Six to eight hundredweight of dried flowers are gathered per hectare. To obtain the powder, the flowers are pounded in a mortar. There are many named varieties of pyrethrum in existence that are exceedingly beautiful. They flower in our gardens in June, and if cut down will often flower again in the autumn.

Electricity and the Growth of Plants.—In the *Proceedings of the Swedish Academy of Sciences*, A. Euler gives the result of some further experiments on the influence of electricity in the growth of plants, chiefly *Elodea canadensis*. He finds that the electrical processes in the atmosphere can have only a slight effect on the amount of dissolved gases in water free from bacteria. Atmospheric electricity, it must be recognised, therefore, can have no direct action on the growth of water plants or of the parts of plants immersed in water.

American Water and Asterionella.—In America, a diatom, *Asterionella formosa*, has proved very troublesome in drinking water, to which it gives a peculiar odour, varying from fishy to geranium-like. This scent is caused by the formation of an oil which has a strong analogy to the essential oils. During periods of stagnation the diatoms form spores at the bottom of the reservoirs, and they increase with very great rapidity when these spores germinate—a growth which takes place chiefly during the spring and autumn. As light greatly favours the growth of this diatom, the best mode of preventing its increase appears to be storing the water in the dark.

The Poisonous Properties of Bryony.—Country children are frequently warned against eating the poisonous berries of *Bryonia dioica*. Several horses have lately been poisoned by eating this plant. They suffered with a very marked stiffness, and their gait was affected. All recovered under the influence of diuretics, together with the application of mustard and embrocation to the loins; but after the poison was eliminated, the animals showed signs of weakness for some days.

OUR SCIENCE SECTION

☛ **Subscribers requiring Explanations of Difficulties in any branch of Science, or Advice upon Courses of Study, can obtain all help required by communicating with the Editor, and accompanying their query with the Coupon cut from this Number.**

STAR STUDY
FOR SCHOLARSHIP STUDENTS.

IV.—MARCH.

OF the constellations already learned, and which it will be the first duty of the student to locate, the following are the most conspicuous at this season of the year:—**In the zenith** will be found Ursa Major, Gemini, and Auriga. **In the north** are Ursa Minor and Cassiopeia. **In the east** Virgo and Leo are to be sought. **In the south** are two constellations that are to be studied this month for the first time; whilst **in the west** Taurus and Aries shine, Orion and Cassiopeia being in the south-west and north-west respectively.

Special attention may at this favourable period be drawn to the four first-magnitude stars forming a large lozenge-shaped figure in the south-west. These are **Betelgeuse** in the north-east angle of Orion, **Aldebaran** in Taurus, **Rigel** at the south-western corner of Orion, and **Sirius** in Canis Major. It may not be superfluous to mention that the mnemonic word BARS gives the initial letters of these four very important stars.

Of the zodiacal constellations, the only ones visible at 9 p.m. are Aries, Taurus, Gemini, Leo, and Virgo.

Constellations not previously mentioned.—Of these there are three that are favourably placed for study during March—(1) **Cepheus**, in the northern part of the heavens; (2) **Draco**, in the eastern region of the celestial sphere; (3) **Canis Minor**, which will be found in the south.

STAR MAP NO. IV. (MARCH).

Cepheus.—The four chief stars in this asterism are—α, of the second, and γ, β, η, of the third magnitude. If a straight line is drawn from δ Ursæ Minoris to β Cassiopeiæ, it will cut halfway between the two stars β Cepheui, the middle star of the arc which is made by the three third-magnitude stars already referred to. The mere fact of this midway position between two such well-known constellations as Ursa Minor and Cassiopeia is quite sufficient to make it easy to find this not very important group of stars, concerning which we need say nothing further.

Draco.—To find the Dragon, one must start from the space between Ursa Major and Ursa Minor. Here will be found to commence a chain of stars of the second and third magnitude, which encircle Ursa Minor and approach very nearly to Cepheus, and which, after receding from this latter constellation, terminate in five stars, four of which form a quadrilateral (β, γ, ξ, ι, μ Draconis), which form the head of the Dragon. Draco always passes over the horizon of London at its lower meridian passage. It should be noticed that the quadrilateral in the head of the Dragon lies on the opposite side of the pole to Capella and Auriga, and about the same distance away, and that the pole is encircled by the body of the Dragon.

Canis Minor.—We have already said that the imaginary line joining δ and β of the body of Ursa Major is produced in a direction opposite to that in which is situated the tail of the Bear. We arrive at the Twins—Castor and Pollux. The student should again, in imagination, draw this same line, and carry it on a little beyond Gemini. A remarkably bright star will be reached. This is the beautiful Procyon, the cynosure of the otherwise unimportant constellation of the Little Dog, Procyon being α Canis Minoris.

The Planets.—Besides the fixed stars that always maintain the same relative position with respect to each other, there are, as was early discovered, seven other celestial bodies that wander about amongst the constellations, and were therefore called the wanderers or planets (Greek, *planetes*, a wanderer). It was also noticed that, whereas the stars shine with a twinkling light, the planets display a disc more or less large, the light from which is constant and not twinkling. It will hardly be necessary to tell the student that this is due to the fact that, whereas the stars are self-luminous, the planets, like the moon, shine with a borrowed light, merely reflecting the light of the sun. The earth is to us the most important of all the planets, but it is by no means the largest, Jupiter being vastly superior in this respect. The mnemonic word MUEMISUN, in which U is simply substituted for V, will help the student to readily recall the names of the planets, and to fix the order of their distances from the sun. The names of the planets are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune, of which the two first are nearer and the five last are further from the sun than the earth, round which they all revolve in orbits that are elliptical, but the axes are so nearly equal that the ellipses are practically circles. It is not intended to give anything like a full explanation or description of celestial objects and phenomena in this place; the student must rely upon the text-book for this. What we do intend is to instruct the student as to the best way in which to recognise and locate the various celestial bodies, of which the planets are by no means the least important; and as one of these latter—namely, Venus—is admirably situated for observation this month, we commence our study of the planets, the position of which we shall now indicate each month. Mercury and Venus being nearer the sun than the earth, are called the **inferior planets**, whilst the remaining five are the **superior**

planets. It follows from this that Mercury and Venus are never far from the sun, and can only be observed just before the sun rises or just after he sets—that is, they are seen either as morning or as evening stars. During the present month Venus is an evening star in Aries, and may be seen shining in the west, just after the setting of the sun, with dazzling brilliance. The student should carefully study Venus, and compare her light with that of Sirius, or any other bright star, so as to appreciate the difference between the twinkling of the star and the constant light of the planet. On the 15th March, Venus does not set until three and three-quarter hours after the setting of the sun. On 4th March, Venus will be found very near the moon.

Mercury is in Pisces, and is at greatest elongation—that is, most remote from the sun—on the 15th March, and is therefore most favourably situated for observation after sunset on that date.

Mars is in Aquarius, and rises shortly before the sun—that is, he is to be seen in the east shortly before sunrise.

Jupiter is a morning star, and is near the moon on the 22nd. The student is recommended to try to see Mercury, and to study Venus carefully. The rest of the planets may be left for future consideration.

NOTES ON PHYSIOLOGY:

EMBRACING THE SUBJECTS OF THE *ADVANCED* AND *HONOURS* STAGES, SCIENCE AND ART DEPARTMENT.

BY WALKER OVEREND, M.A., M.D. (OXON), B.SC. (LONDON),

Physician to the Tottenham Hospital;
Late Radcliffe Fellow, Scholar of Balliol College, and Exhibitioner in Comparative Anatomy of the London University.

WITH regard to the text-books on this subject, Foster and Shore's *Physiology for Beginners*, Huxley's *Lessons on Physiology*, published by Macmillan, or *Elementary Physiology*, by B. Moore, M.A., published by Longmans, Green, and Co., may be recommended. For the advanced stage, either Yeo's *Manual of Physiology*, 14s. (Churchill), or Kirke's *Handbook of Physiology*, edited by Professor Halliburton, Fourteenth Edition, also published at 14s. (J. Murray), will be found useful. Starling's *Elementary Physiology* (Churchill), published at 6s. 6d., is a helpful and suggestive book.

We shall now consider the questions set at the advanced evening and day examinations in 1899. The first two questions in each paper are the most important. Only six questions out of eight are to be attempted; but it is always advisable, if possible, to answer the first two, inasmuch as each counts about double the number of marks allowed for any one of the others. In each paper, the first two questions refer to the circulation and respiration.

21. Describe the muscular movements which take place during ordinary quiet respiration. What part of the central nervous system determines and governs these movements? What nerves may be stimulated so as (1) to quicken, (2) to slow, the movements of respiration? (50).

During an ordinary *quiet* respiration, with each *inspiration* the cavity of the thorax is enlarged in all dimensions, from above downwards, by the contraction of the diaphragm, and in its transverse and antero-posterior diameters by the movements of the ribs and sternum. The latter is accomplished by the contraction of the *external intercostal* muscles and the *levatores costarum*. When these muscles cease to act, the lungs, which have been stretched by the previous inspiration, contract by virtue of the elastic tissue they contain, and the thorax sinks by its own weight and by the elastic recoil of the stretched cartilages of the ribs. This constitutes *expiration*. There is then a *pause* before the next inspiration begins.

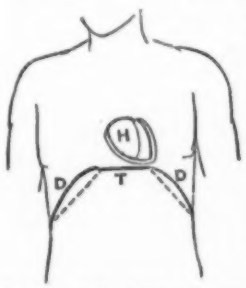


Diagram of the Diaphragm: H, heart; T, tendon of diaphragm; D, D, its muscular fibres. The dotted lines show position of these fibres during inspiration.

The movements leading to inspiration are brought about by the aid of the muscles already mentioned, and these muscles are brought into play, so as to act together, through the agency of nervous impulses sent along their motor nerves. The motor

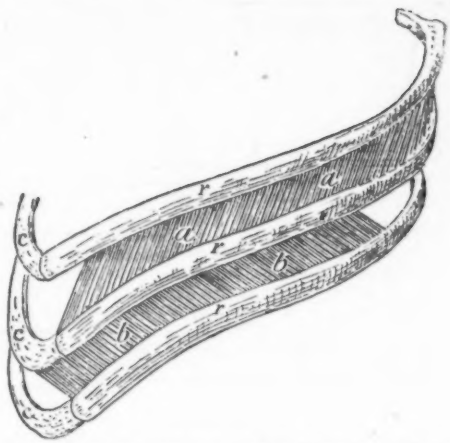
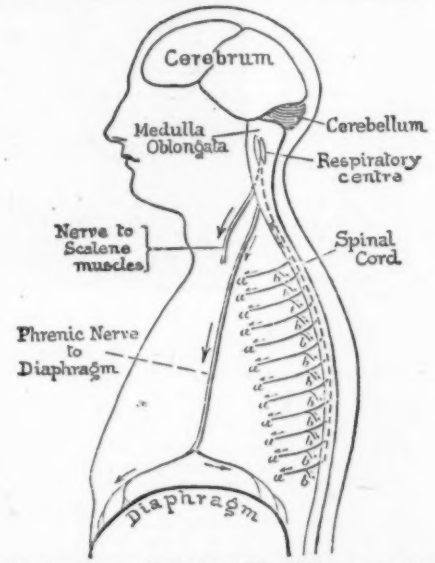


Diagram showing the direction of the External Intercostal Muscles, *a*, *a*; Internal Intercostals, *b*, *b*; Costal Cartilages, *c*, *c*; Ribs, *r*, *r*. The space between *c* and *b* should have been completely filled with muscular fibres of the internal intercostal muscles.

nerves for the levatores costarum and external intercostal muscles come from the *intercostal* nerves (Fig. 4), and those for the diaphragm—of which there are two, one on each side—are called the *phrenic* nerves. If the phrenics are both divided, the diaphragm ceases to move. The impulses start from a part of the medulla oblongata, into which the vagus nerves enter, called the *respiratory* centre. If this part is injured, respiration stops, and death ensues.

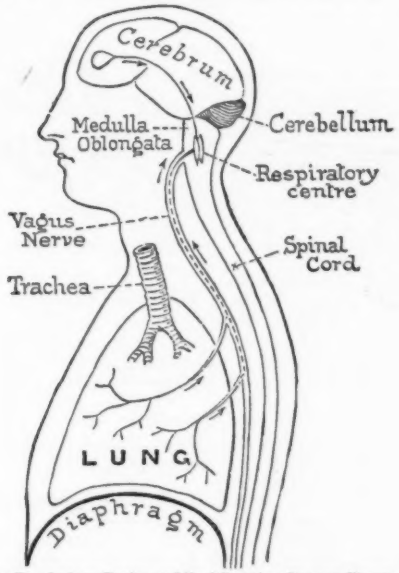
Diagram of the action of the Levatores Costarum: *e*, *e*, posterior surfaces of the vertebrae; *c*, *c*, transverse processes; *a*, *a*, levatores costarum; *d*, *d*, ribs.

The vagus nerves send a *pulmonary* branch to each lung, which ends in the air cells. When the air cells are distended by inspiration, these nerves are stimulated, and carry up impulses to the respiratory centre and liberate an expiratory stimulus. Also the collapse of the air cells in expiration stimulates the endings of the vagus nerve in the air cells, and starts off impulses which check expiration and hurry on the next inspiratory movement. If the vagus nerves be divided, the respiratory movements become



The Respiratory Centre and its Motor or Efferent Nerves: *a*, *a*, *a*, nerves to intercostal muscles; *b*, *b*, to levatores costarum muscles.

much diminished in number; and if the ends in connection with the brain be then stimulated by the electric current, respirations quicken again. Stimulation of certain nerves will retard respiration. For instance, a dash of cold water on the face or skin of



The Respiratory Centre and its Afferent or Sensory Nerves.

the thorax will cause a deep inspiration, and stop respiration for a time. This is due to stimulation of the cutaneous nerves. Similarly, when a crumb or other particle of food comes in contact with the mucous membrane of the larynx, an expiratory effect is produced, and respiration is also slowed. This is due to stimulation of the *superiorl aryngeal* nerves which come from the vagi.

22. Describe carefully the movements which the heart makes, and the changes of shape which it undergoes, during one complete "beat." What sounds accompany each beat of the heart, and how are they produced? (50).

If the heart of a rabbit be exposed by opening the chest, and the animal be kept alive (by means of artificial respiration), the movements can be observed.

The great veins near the heart—the venæ cavæ and pulmonary veins—first contract, and immediately afterwards the two auricles contract sharply down towards the ventricles. Then the ventricles contract together, and at each contraction it may be observed that the apex of the heart turns a little forwards and to the right. For a short time the heart is now quiet, and then the veins commence again. It is difficult to follow these movements if the heart is beating quickly, but easier if the beats are slower.

In man, a cardiac *cycle* or *beat* takes up about eight-tenths of a second, and the time is occupied thus:—

(*a*). *Systole of auricles*, one-tenth of a second.

1. Blood driven into the ventricles, and auriculo-ventricular valves float upwards partly.

(*b*). *Systole of ventricles*, three-tenths of a second.

First Sound.
1. Contraction of auriculo-ventricular orifices.
2. Closing and stretching of the auriculo-ventricular valves.
3. Dispatch of blood through the semilunar valves, which are forced open.

Second Sound.
4. Closing and stretching of the semilunar valves.

(*c*). *Pause or diastole*, four-tenths of a second.

The second sound is due to the stretching of the semilunar valves when they are closed by the pressure of blood behind them. The first sound, which is a longer and duller sound, is due partly to the tension of the auriculo-ventricular valves, and partly due to the muscular sound produced when the muscle of the ventricles contracts (ventricular systole). During contraction the ventricles become shorter from above downwards, and in cross-section change from an elliptical to a circular form; and there is a twisting, causing the apex to tilt forwards and to the right at each contraction.

23. Describe (*a*) the structure of a lymphatic gland. How are lymphatic glands connected with lymphatic vessels? What causes lead to the flow of lymph along the vessels and through the glands?

Describe the structure under the headings:—

1. *Capsule* and *trabeculæ*.
2. *Cortex* (lymph follicles, lymph sinuses).
3. *Medulla* (lymph follicles, lymph sinuses).
4. *Adenoid tissue*, consisting of a fine network containing lymph corpuscles, etc.

The lymphatic glands lie in the course of the lymphatic vessels. Several afferent vessels enter the capsule, and pour their contents into the lymph paths or sinuses within the cortex. The efferent vessels come out at the hilum, forming wide channels. During its passage through the complicated system of spaces the movement of the lymph is much retarded. Many of the lymph corpuscles are washed out of the gland by the lymph stream, and finally reach the circulation, where they become the white corpuscles.

Forces moving the lymph. Enumerate in this order:—

1. Contraction of the muscular fibres in the villi.
2. At the point where the thoracic duct enters the great veins of the neck, the pressure is less than in the thoracic duct and small lymphatic vessels. It may be a negative pressure, and must therefore exert a kind of suction action, drawing the lymph and chyle towards the neck.
3. The lymph vessels are provided with valves which only allow the lymph to pass towards the neck, so that all muscular movements, by pressing on the lymphatics, must help in the flow.
4. The movement of inspiration must also assist, since the negative pressure in the chest is then increased.

MATHEMATICS.

STAGES 2 AND 3, SCIENCE AND ART DEPARTMENT.

BY G. A. BAXANDALL,

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Stage 2.

Algebra.

Surds.—Read from one of the following text-books:—

Hall and Knight, chap. xxxi., especially Arts. 259, 265, 266, 270, 271, 277, 281.

C. Smith, chap. xx., especially Arts. 185, 187; also Ex. 4 and 5, p. 166.

H. Smith, chap. xxiv., especially Arts. 301, 308, 315; also chap. xxv.

Todhunter and Loney, chap. xxx., especially Arts. 315, 316, 319, 324, 325, 328.

Select examples from the sets which are given in each text-book.

Work the following examples:—

1. Simplify $\sqrt{18} - \sqrt{147} + \sqrt{72} + \sqrt{108} - \sqrt{128}$.

Ans. $\sqrt{2} - \sqrt{3}$.

2. Reduce to its simplest form—

$$\frac{1 - \sqrt{2} + \sqrt{3}}{1 + \sqrt{2} + \sqrt{3}} - \frac{1 - \sqrt{2} - \sqrt{3}}{1 + \sqrt{2} - \sqrt{3}}.$$

Ans. $2\sqrt{3}$.

3. Find all the roots of the equation—

$$2x + \sqrt{x + 9} = 1.$$

Ans. $\frac{5 \pm 3\sqrt{17}}{8}$.

4. Is $2\sqrt{5} + 7$ *greater* or *less* than $\sqrt{5} + \sqrt{23}$?

Ans. Greater.

Trigonometry.

Logarithms.—Read the articles or chapter from one of the following text-books:—

Hall and Knight, chap. xiv.

Hamblin Smith, chap. xiv.

Loney, chap. x.

Lock, chap. xiv.

It is a very curious fact that probably the majority of students first become acquainted with the use of logarithms during a study of *trigonometry*, generally immediately before considering the *solution of triangles*. In studying the latter we have to make numerical calculations; but whenever these have to be made, no

matter what subject the numbers relate to, the use of logarithms lightens the work immensely. The subject of logarithms, so far as their application is concerned, really belongs to *arithmetic*.

It is *not* advisable to first read through *every article* in the above chapters; the proofs of the rules may be read later.

1. The definition of a logarithm, especially of a *common* logarithm, should be known.

2. Frequent use should be made of the following:—

$10 = 10^1$	$\cdot0001 = 10^{-4}$	log $\cdot0453$	$= \bar{2}\cdot6561$
$100 = 10^2$	$\cdot001 = 10^{-3}$	log $\cdot453$	$= \bar{1}\cdot6561$
$1000 = 10^3$	$\cdot01 = 10^{-2}$	log $4\cdot53$	$= 0\cdot6561$
$10{,}000 = 10^4$	$\cdot1 = 10^{-1}$	log $45\cdot3$	$= 1\cdot6561$
etc.	$1 = 10^0$	log 453	$= 2\cdot6561$

From the equations on the left we see, from the definition, that 1, 2, 3, 4, etc., are the common logarithms of 10, 100, 1000, 10,000, etc. This being the case, we can see that since 453 lies between 100 and 1000, its logarithm will lie between 2 and 3.

Again, starting from 10,000 and working upwards in the column of numbers, we observe that as we continue to *divide by 10*, we continue to *diminish the logarithm by 1*, and carrying on this process, we obtain the equations in the middle. Further, if we are told that log 453 is $2\cdot6561$, we can by the same process build up the set of equations on the right, where $\bar{1}$ means -1.

3. The logarithm of every number consists of an *integral* part and a *decimal* part. The integral part may be positive, zero, or negative, but we agree to arrange that the decimal part shall *never be negative*.

4. For any number we can always without difficulty write down the *integral part* by inspecting the left-hand or the middle column of numbers shown above. For example, 4530 lies between 1000 and 10,000, hence log 4530 lies between 3 and 4. It is therefore 3 + a decimal. Since it is always possible to find the integral part, it is only necessary to *print* the decimal portion. This is what appears in tables of logarithms. In such a table, opposite the *number* 4530 we should find the logarithm 6561, which means $\cdot6561$. Hence log 4530 is $3\cdot6561$.

Again, if we want the logarithm of $\cdot00453$, inspect the middle column above, or, if this is troublesome, move the decimal point temporarily, so as to give, say, $45\cdot3$. Now log $45\cdot3$ is $1 +$ a decimal, and by the help of a table of logarithms we find log $45\cdot3$ to be $1\cdot6561$. Now move the decimal point in $45\cdot3$ to the left, *one* place at a time, diminishing the logarithm by 1 each time, until we arrive at log $\cdot00453 = \bar{3}\cdot6561$. This artifice of temporarily moving the decimal point is a useful one in all decimal calculations.

5. The use of the rules for logarithms is, of course, the main object we have in view, the proof of them being a secondary matter. The rules are—

$$\log mn = \log m + \log n.$$

$$\log \frac{m}{n} = \log m - \log n.$$

$$\log m^n = n \log m.$$

$$\log \sqrt[n]{m} = \frac{1}{n} \log m.$$

6. $\bar{1}\cdot6283$ means $-1 + \cdot6283$, or $-\cdot3717$; and $-1\cdot8125 = -1 - \cdot8125 = -1 - 1 + \cdot1875 = \bar{2}\cdot1875$.

We shall assume each student to be in possession of a table of logarithms such as was recommended in November last.

Work the following examples by using a table of logarithms (the answers given are obtained by using four-figured logarithms):—

1. Find the value of $4\cdot326 \times \cdot003457$; $\cdot01584 \div 2\cdot104$.
Ans. $\cdot01495$; $\cdot007529$.

2. Calculate ab and $a \div b$ when
$a = 1323$; $b = 24\cdot32$. Ans. 32175; $54\cdot4$.
$a = 17\cdot56$; $b = 143\cdot5$. Ans. 2520; $\cdot1224$.
$a = 0\cdot564$; $b = \cdot2471$. Ans. $\cdot1394$; $2\cdot283$.

3. Calculate ab when
$a = 20\cdot52$ and $b = 2$. Ans. $421\cdot1$.
$a = 1\cdot564$,, $b = 1\frac{1}{2}$. Ans. $1\cdot956$.
$a = \cdot5728$,, $b = 3$. Ans. $\cdot1879$.
$a = 60\cdot71$,, $b = -\frac{1}{9}$. Ans. $3\cdot930$.

4. Calculate $5^{2\cdot43}$; $\sqrt[5]{246\cdot3}$; $3^{-0\cdot248}$.
Ans. $49\cdot95$; $3\cdot008$; $\cdot7632$.

5. Find the value of

$$\frac{78\cdot79 \times 32\cdot39 \times \cdot079 \times \sin 137^\circ 40'}{\pi x (3\cdot3)^2 \sqrt{15} \tan 140^\circ}.$$

N.B.—Sin $137^\circ 40'$ = sin $42^\circ 20'$ = $\cdot6734$; hence log sin $137^\circ 40$ = log $\cdot6734$. Also, tan 140° = − tan 40° = − $\cdot8391$. The answer will be negative; therefore ignore the *minus* in the logarithmic work. Ans. $-1\cdot222$.

Geometry.

Read Props. 14 to 24, Book III., of which 20, 21, and 22 are the most important.

Select and work riders from your text-book.

Stage 3.

Algebra.

Permutations and Combinations.—Hall and Knight, chap. xi., more particularly the formulæ in Arts. 141, 142, 144, 146, 151, and 156. Read carefully over all the examples which are fully worked out. Art. 140 is the most important one.

Intermediate Algebra.—Briggs and Bryan, chaps. xx. and xxi., more particularly the formulæ of Arts. 295, 297, 298, 305, 306, 310, 320. Read carefully through the examples which are worked out. Art. 288 is the most important one.

Todhunter and Loney, chap. xxxviii.

Select examples from the various sets to be found in each text-book.

Also work the following:—

1. Out of forty consecutive integers, in how many ways can three be selected whose sum shall be even? (1899.)
Ans. 4940.

2. Find how many different numbers, of four figures each, can be formed, when any of the six figures 1, 1, 2, 2, 3, 4 may be used. (1898.) Ans. 102.

Trigonometry.

Properties of Triangles and Polygons.—Hall and Knight, chap. xviii.; Loney, chaps. xv. and xvi.; Lock, chaps. xix. and xx.; Todhunter, chap. xvi.

Let the student understand exactly what is necessary in connection with the following parts of the subject:—

1. The formulæ for the area of a triangle, having given (1) three sides, (2) two sides and the included angle, (3) one side and all the angles—*three* distinct formulæ.

2. The formulæ for the radii of the inscribed, circumscribed, and escribed circles of a triangle. Many exercises have been built around these formulæ, and the student is expected to work many of these. In order to work such exercises the formulæ themselves must be learned, but the proofs of them should be written out time after time; this is the simplest of book work. Now these exercises are easy if the student be familiar with and ready to use the formulæ—

$$\sin \frac{A}{2} = \sqrt{\frac{(s-b)(s-c)}{bc}}, \cos \frac{A}{2} = \sqrt{\frac{s(s-a)}{bc}},$$

as well as those for the area of a triangle.

3. The formulæ for the area of a polygon should not be remembered. The practice one obtains in proving them, whenever they are wanted, is useful. We might say the same of the formulæ for the radii of the circles of a triangle but for the fact that they are required so often.

4. The area of *any* quadrilateral; of a cyclic quadrilateral; of a cyclic quadrilateral such that one circle can be inscribed in it.

5. The expressions for the distances between the centres of the various circles of a triangle.

6. Length of a tangent from a corner of a triangle to the inscribed or escribed circle.

7. A little about the pedal triangle.

It would be highly ridiculous of a student to think that all these formulæ should be remembered. He should spend much time proving them, for this sort of exercise is extremely valuable.

It is also well to remind one that this is not an important part of trigonometry. This and other portions are not to be compared with the more important part dealing with compound angles, to which we have already referred. Exercises on the latter should be worked every week, or as often as time permits.

There are many exercises on triangles and circles in the text-books; the student must make a selection from them.

Geometry.

Read Props. 6 to 17, Book VI.; of these, 8, 12, and 13 are important.

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NOTES ON THEORETICAL MECHANICS.

BY F. CASTLE, M.I.M.E.,

Royal College of Science; Lecturer on Mechanics, Geometry, etc., Morley College, London; Author of "Elementary Practical Physics," etc.

ADVANCED AND HONOURS STAGES.

It is assumed that the student who has followed these notes can now without much difficulty (when the requisite data are given) obtain the *total resultant*, or the *pressure at a given point*. The pressure at a given point denotes the pressure on a small area, or unit area, at the point; the magnitude of the pressure is directly proportional to the depth of the point below the free surface of the liquid. If the small area considered be removed, or, in other words, if a small orifice be made in the side or bottom of a vessel, the liquid will issue from the orifice with a velocity directly proportional to the distance of the orifice below the free surface, and this distance would, when accurate measurements are made, include the height of the water barometer.

From the laws of falling bodies we know that, when a body is let fall from a position of rest, the velocity v, in feet per second, acquired in falling freely through a distance h, is given by $v^2 = 2gh$, where g (the acceleration due to gravity) is equal to 32·2, or, approximately, 32 feet per second.

This formula also applies to liquids. Thus any small mass m, of weight mg, at a height h, has potential energy mgh; hence, neglecting the viscosity of the liquid, or the work done against resistances, the potential energy of the mass m may be equated to the kinetic energy gained by that mass in falling.

$$\therefore \tfrac{1}{2}mv^2 = mgh,$$
$$\text{or } v = \sqrt{2gh}. \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

From (1) it is obvious that so long as the liquid is maintained at a constant level, the velocity v will be constant. The relation between v and h given by (1) is known as *Torricelli's theorem*.

The viscosity or energy lost, due to imperfect fluidity, has been neglected, and therefore it follows that the theorem will give a velocity which is in excess of the actual velocity. By the velocity is meant the speed with which, say, a small speck of dust would be carried along by the liquid. It should be noticed that if the orifice be made in the side of a vessel, the liquid will be projected in a horizontal direction with a velocity $\sqrt{2gh}$. As there is also an acceleration in a vertical direction equal to g, the jet of liquid will describe a parabolic path. If the jet were directed upwards, the highest point reached by the liquid should be that of the horizontal plane passing through the surface of the liquid in the vessel. On account of the viscosity, together with other resistances, such as the resistance of the air, it never quite reaches such a height.

If a denote the area of the orifice, and Q_1 the quantity which escapes per second, then $Q_1 = kav. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$

k is a constant, usually called the *vena contracta*, the value of which depends upon the form of the orifice.

The numerical magnitude of k may in a few cases be obtained from theoretical considerations. It is, however, often found by experiment.

For an orifice in a thin plate the value of k is ·62. If a small tube, of bore $\frac{1}{2}$ to $\frac{1}{3}$ its length, be fitted to the orifice, the outflow is increased, k being ·81.

To find the value of k experimentally, the height or "head" is kept constant, and the quantity Q, which flows in a given time t, is obtained and measured. Then, as Q, a, t, and h are known, the value of k may be obtained from the formula

$$Q = kat\sqrt{2gh}. \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

In problems connected with the steady flow of water from one place to another, the fundamental law is—

$$\frac{v^2}{2g} + h + \frac{P}{W} = \text{constant}, \quad . \quad . \quad . \quad . \quad . \quad (4)$$

where h is the height or head in feet, v the velocity in feet per second, P the pressure per square foot, W the weight of a cubic foot of water.

The pressure, P, may be applied by means of a piston, or in any convenient manner. In the majority of problems in this subject the last term is zero, and it is only necessary, as in equation (1), to equate the potential and the kinetic energy.

Ex. 1. The orifice in the side of a tank is one square inch; the water is maintained at a constant level of two feet above the orifice; the amount of water which flows through the orifice in 30 seconds is found to be 1·465 cubic feet. Find the value of k, the *vena contracta*.

Here $a = 1$ sq. in. $= \frac{1}{144}$ sq. ft.
$h = 2$ ft., $t = 30$, and $Q = 1{\cdot}465$.
$\therefore 1{\cdot}465 = k \times \frac{1}{144} \times 30\sqrt{2g \times 2}$
$= k \times \frac{1}{144} \times 30\sqrt{64{\cdot}4 \times 2}.$
$\therefore k = {\cdot}62.$

Ex. 2. A reservoir is kept full, so that the surface of the water is at a constant height of 12 feet above a small hole, the effective area of whose cross-section is $\sqrt{3}$ square inches. Find how many cubic feet of water flow out in an hour. ($g = 32$.) (1889.)

Here $a = \frac{\sqrt{3}}{144}$ sq. ft., $g = 32$, $h = 12$,
$t = 60 \times 60 = 3600$ seconds, k is unity.

Hence from (3),

$$Q = \frac{\sqrt{3}}{144} \times 3600\sqrt{64 \times 12}.$$
$$\therefore Q = 1200 \text{ cubic ft.}$$

Ex. 3. State Torricelli's theorem for the velocity of a jet issuing from a small hole in a vessel full of water, and the reasoning by which it is established. A cylindrical vessel, with a small hole at the bottom, is 4 feet high, and is capable of containing 4 cubic feet of water. It is kept full, and it is found that 4 cubic feet of water flow out of the hole in 30 minutes. What is the size of the hole? ($g = 32$.) (1885.)

Here $Q = 4$, $t = 3 \times 60$, $g = 32$, $h = 4$.

From (3) we have

$$4 = a \times 3 \times 60\sqrt{64 \times 4}.$$
$$\therefore 4 = a \times 180 \times 16,$$
$$\text{or } a = \frac{4}{180 \times 16} \text{ sq. ft.}$$
$$= \frac{4 \times 144}{180 \times 16} = \tfrac{1}{5} \text{ sq. in.}$$

Ex. 4. A hole, one square inch in sectional area, is bored in the vertical side of a large vessel containing water to a height of 3 feet above the hole. Assuming a *vena contracta* of probable dimensions, determine the number of gallons that will escape in five minutes. ($g = 32$.) (1898.)

Here $a = \frac{1}{144}$ square feet, taking k, the value of the *vena contracta*, to be ·62.

Then $Q = \frac{1}{144} \times {\cdot}62 \times 5 \times 60\sqrt{64 \times 3}$
$= 17{\cdot}89$ cubic ft.

Taking 62·3 lbs. as the weight of a cubic foot, and 10 lbs. as the weight of one gallon, then we have

$$\text{Number of gallons} = \frac{17{\cdot}89 \times 62{\cdot}3}{10}$$
$$= 111{\cdot}5.$$

Ex. 5. If the pressure of the air is at the rate of 14·88 lbs. per square inch, and the weight of a cubic inch of air is taken to equal 0·31 grain, with what velocity would the air begin to rush into a vacuum through a small hole in the side of the empty vessel? (1882.)

Ans. 1340 ft. per second.

Ex. 6. A vessel of water 9 feet high is kept constantly full of water; a hole, whose area is a quarter of a square inch, is made in its bottom. What would be the theoretical outflow in one hour? How would the actual outflow differ from the theoretical outflow? (1893.)

Ans. 150 cubic ft.

Ex. 7. A cylindrical vessel is 10 feet high, and its base, which is horizontal, has a radius of 1 foot. It is filled with water, and a small hole is made in the bottom. Compare the rate of descent of the surface when the hole is first opened with the rate when the vessel is half empty. If the vessel is half emptied in twenty minutes, what is the effective area of the hole? (1892.)

Ans. $\sqrt{2} : 1$. ·087 sq. in.

Ex. 8. A cylindrical vessel has a small hole in its bottom; it stands upright, and is filled with water. Find an expression for the time in which half the water will run out. (1896.)

Certificate Examination, 1900.

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NOTES ON ADVANCED AND HONOURS PHYSIOGRAPHY.

Orange River Ground Moraine.—This moraine, which lies near Prieska, is described by Messrs. Swartz and Rogers in the *Proceedings of the South African Philosophical Society*. Sections near Prieska show an ancient morainic conglomerate passing underneath the so-called Kimberley shales, and lying unconformably on the older jasper rocks, quartzite and granite. The conglomerate contains numerous striated boulders, and the underlying rock often presents a rounded, scratched surface, which frequently forms distinct *roches moutonnées*. The ice passed from north to south. The authors are of opinion that this conglomerate represents the land-formed ground moraine of the ancient glacier, whose water-borne detritus has elsewhere formed the Dwyka conglomerate.

Brilliant Meteor.—Mr. Samuel Barber informs *Nature* that on 28th January he observed a very brilliant meteor at Chesterton, near Peterborough, at about five minutes to six in the evening. Attention was drawn to the meteor by an almost blinding flash resembling lightning. Then the ball of light was observed travelling across the sky like a large rocket in an easterly direction, with a conspicuous trail a few degrees wide on either side of its course. Before vanishing there was a distinct gap left, in which the trail did not appear—that is, between the point of departure of the meteor and the end of the trail. The meteor disappeared instantaneously. No sound was heard.

The Spectrum of Silicon.—Sir Norman Lockyer has contributed two papers on stellar spectra to the Royal Society, which deserve the careful attention of honours students, concerning silicon, or silicium, as Sir Norman prefers to call it. He says that the recent observations show that the lines of silicium may be divided into three sets, no two of which behave alike under varying electrical conditions. The wave lengths and the lines comprising the different sets are:—

3856·1	4089·1	4552·8
3862·7	4116·4	4568·0
4128·1		4575·3
4131·1		
A	B	C

There is a line at 3905·8 which is associated in the spark spectrum of silicium with the lines in set A; but while these are absent from the arc spectrum of silicium, 3905·8 is a strong line in the arc spectrum. This line differs from the others, therefore, in not being enhanced in intensity in passing from the conditions of the arc to those of the spark. So far as is known, the lines in sets B and C have not been recorded by any other observers of the silicium spectrum.

It is found, on investigating the occurrence of these silicium lines in stellar spectra, that the three sets of lines respectively attain a maximum intensity at the three different levels of stellar temperature represented by β, γ, and ζ Orionis. It is found that set A is most prominent in the spectrum of β Orionis, that set C predominates in the spectrum of γ Orionis, and that set B is by far the strongest in that of ζ Orionis.

That the stars named represent three different grades of temperature—ζ Orionis being the hottest, and β Orionis the coolest—has been previously deduced by the discussion of other lines in their spectra.

It was recently shown that silicium made its appearance first at the temperature represented by α Ursæ Minoris, and strengthened at the higher temperatures of α Cygni and β Orionis, afterwards weakening as we pass through the still higher temperatures of ζ Tauri and γ Orionis, until at the ζ Orionis stage it is bordering on extinction.

Wave Lengths of Enhanced Lines.—The important part which the enhanced lines of the element play in the study of stellar spectra cannot be overestimated, but a great advance can only be made in this direction by the systematic examination of the spectra of all the elements. The author has been fortunate enough to have the use of the large 42-inch Spottiswoode coil, and employed it in this work, for which it is specially adapted, as the brilliancy of the spark shortens the time of exposure. The elements which have to be dealt with in this investigation are the following: Al, Bi, Cr, Cu, Fe, Mg, Mn, Ti, and V. For each of these elements the spark and arc spectra were photographed and compared, and the wave lengths of the **enhanced lines**—that is, those lines that are *intensified in passing from the temperature of the electric arc to that of the spark*—were determined, and tables are given of their wave lengths.

An illustration (given in the January number of THE PRACTICAL TEACHER) shows the enhanced lines and the arc lines in the spectrum of titanium.

The Eclipse of 1898.—Accounts of the phenomena accompanying the eclipse of 1898 have not as yet drawn attention to two curious facts—namely, the lulling of the wind and the lowering of the temperature whilst the eclipse of the sun was in progress. At Seoni, where full obscuration lasted from 1 hr. 27 min. to 1 hr. 28¼ min. p.m., the observer remarked: "Everything quiet and calm; wind totally stopped from 1 hr. p.m. to 2 hrs. 10 min. p.m." At the same station it was noted that there was a decrease in temperature of 5° in the 1¼ min. of obscuration.

Earthquake Sounds.—Dr. Davison, writing in *The Philosophical Magazine* for January, says that the earthquake sound is generally deep and rumbling, like that of a heavy wagon passing; sometimes it resembles thunder or wind more closely, the fall of heavy stones, or the firing of distant cannon. Near the epicentre of the earthquake loud crashes are heard by some, but not all, observers at the time when the shock is strongest; further away, it becomes rougher and more grinding at the moment; while at a great distance, the sound is throughout smooth and almost monotonous, like the sound of distant thunder. The neighbourhood of the sound to the lower limit of audibility is shown by the fact that it is heard by some observers like the rumbling of a heavy traction-engine passing, while others equally alert hear no sound at all. In strong earthquakes the sound area occupies a region surrounding the epicentre; in weak ones the sound area and disturbed area approximately coincide, or the former area overlaps the latter; while in certain districts the sound is sometimes heard without any shock being felt. Several instances of the occurrence of these earth-sounds are given, it being claimed by the author that they represent earthquakes too weak to be felt. It is the opinion of Dr. Davison that the cause of earthquakes is to be sought in fault-slips, and that the sound vibrations come chiefly from the margins of the area of displacement, and he proceeds to show that this theory accounts for all the known phenomena of earthquake sounds.

CHEMISTRY NOTES.

BY THOMAS CARTWRIGHT, B.A., B.SC. (LOND.),
First Class Honoursman in Chemistry.

Purification of Natural Waters.—Oxidising agents naturally occupy a preponderating place in the biological purification of natural waters, and amongst these the most valuable are the permanganates. A difficulty in the way of the general use of these purifiers has been the impurities that are a result of the reaction. For example, the use of $K_2Mn_2O_8$ and lime gives rise to the presence of free alkali in the water, and small quantities of lime make the water absolutely unfit for drinking purposes. This difficulty has been completely done away with by M. Tixier, who uses permanganate of alumina and permanganate of baryta in variable proportions. The following are the reactions which take place—

$$Al_2(Mn_2O_8)_3 = Al_2O_3 + 3Mn_2O_3 + O_{12},$$

with waters free from $CaSO_4$, in which case only minute quantities of $Ba(OH)_2$ would be necessary.

With waters containing $CaSo_4$ the reactions are:—

$$CaSO_4 + BaMn_2O_8 = BaSO_4 + CaMn_2O_8.$$
$$CaMn_2O_8 + Al_2(Mn_2O_8)_3 = CaOAl_2O_3 + 4Mn_2O_3 + O_{16}.$$

These reactions take place easily in the cold, and the quality of a water can be determined five minutes after the addition of the first drop of the reagent; in some cases the reaction is instantaneous.

The Solubility of O and of N in Water.—Messrs. French, M.A., and Ashworth, B.A., of the Grammar School, Bury, have contributed to *The Chemical News* (January 12) an article in which they describe a method, admirable in its simplicity and surprisingly accurate in its working, for the determination of the solubility of nitrogen and oxygen in water. The apparatus consists of two burettes, A and B. A is inverted, and is provided with a funnel at the top, which is attached to the constricted end of the burette by means of rubber, and to the bottom end of which is fitted a rubber cork carrying a piece of glass tubing, to which is fitted pressure tubing provided with a clip. The burette B stands in its usual position, the bottom or constricted end being fitted to the other end of the pressure tubing already spoken of, this end also being furnished with a clip. The authors thus describe the working of their simple contrivance:—"Mercury is placed in B, which is raised until the metal begins to pass into the funnel; cold, well-boiled distilled water is added to the funnel, and B is quickly lowered so that about 30 c.c. of water pass into A; the funnel is removed and the gas supply attached to A, and about 5 c.c. of the gas drawn

in. Water is now added to B, so that the height of the water in each side is the same *when the mercury levels are the same* (the reason of this is obvious), and the volume of water and gas, taken quickly, read off. The stopcock of B is now closed (or the tubing is pinched), and the burette A is well shaken; B is then opened, the levels equalised, and the diminution of gas noted: this is repeated until the diminution is constant. The volume of gas dissolved is reduced for temperature and pressure, and the solubility obtained in the usual way." A further addition to the apparatus may be made in the shape of a T-piece connecting the two burettes to a third burette, the pressure tubing being cut in the middle in order to attain this object. This third burette, as the authors state, greatly facilitates the work, in forming a reservoir for the mercury, but it is not essential. The results obtained by students using this simple apparatus in the Bury Grammar School laboratory are given below in comparison with the theoretical results as given in Bayley's *Chemists' Pocket Book*. The practical agreement of these two expressions of the solubility of oxygen and nitrogen shows how very accurate the method is.

Oxygen.	Nitrogen.	Air.	CO_2 formed.
0·02879 15° C.	0·0151 15° C.	0·01729 19° C.	0·952 15° C.
0·02989 ,,	0·01478 ,,	0·01719 ,,	1·002 ,,
(Bayley)	(Bayley)	(Bayley)	(Bayley)

NH_3, HNO_2, and HNO_3 in Natural Waters. — Herr Winkler, the great authority on water analysis, has lately set out in the *Chemiker Zeitung* some modifications of method in respect to the estimation of the above bodies in water.

1. **NH_3.**—The difficulty here is that when the Nessler solution has been added to distilled water, and NH_4Cl is then passed in, the solution becomes cloudy, and it is no longer possible to compare the colour of this solution with the solution of the water under examination to which Nessler's solution has been added. Herr Winkler has found that when a tartrate such as Seignette salt is present, the NH_4Cl produces no cloudiness upon addition, and so the colorimetric determination can be completed. The following is the method employed:—Two flasks fitted with ground-glass stoppers, and of a little more than 100 c.c. capacity, are required. Into one of these flasks is poured 100 c.c. of the water to be examined, and into the other 100 c.c. of distilled water free from NH_3; to each of these flasks are now added 2 or 3 c.c. of a solution of Seignette salt and a similar quantity of Nessler solution. To the flask containing the distilled water is added, drop by drop from a burette, a solution of NH_4Cl, of which each c.c. contains a quantity of chloride equal to 0·1 gramme of NH_3. The flask is frequently shaken, and the addition of the chloride stopped when the distilled water has taken the same tint as the water under examination.

2. **HNO_3.**—Take one volume of a very dilute solution of nitrate (1 : 100,000) with two volumes of H_2SO_4, and dissolve in this liquid, when cold, a small quantity of brucine: a beautiful rose-red coloration is produced, which on standing becomes first orange yellow, and finally citron yellow. If the solution is warm, the red colour immediately gives place to the yellow. The intensity of the colour is in direct ratio with the quantity of acid present. The following is the method adopted:—Two small flasks of 50 c.c. each are used: into one of these is poured 10 c.c. of the water to be examined, and into the other 10 c.c. of distilled water. To each of the flasks is added 1 c.c. of a 2 per cent. solution of sulphate of brucine, and then 20 c.c. of H_2SO_4. The nitrated water becomes yellow, whilst the distilled water remains colourless—that is, if the sulphate is free from nitrate. A solution of KNO_3 is then added drop by drop to the distilled water, of which each c.c. contains 0·1 gramme of nitric acid, until the tints are the same in the two flasks, when the determination is complete.

3. **HNO_2.**—To detect nitrous acid in water, a small quantity of KI must be dissolved; then a little starch solution is added, and a few drops of H_2SO_4, when the following reaction takes place:—

$$HNO_2 + HI = NO + I + H_2O, \text{ or}$$
$$N_2O_3 + 2HI = 2NO + I_2 + H_2O.$$

The following is the method employed:—Take 100 c.c. of the water under examination: if it is cloudy or coloured yellow by ferric hydrate, it must be cleared by sedimentation and filtration. The sample taken is placed in a long-necked 200 c.c. flask, and 20 c.c. of 10 per cent. HCl solution and 2 or 3 c.c. of starch solution are added. To this mixture is then gradually added 5 grammes of pure crystals of $KHCO_3$, about a gramme at a time, waiting a little after each addition, so that the froth may not run over. When four-fifths of the salt have been added, a small crystal of KI is thrown in, then the remainder of the bicarbonate, so that the NO formed by the action of the HNO_2 on the HI is driven out of the flask. The iodine thus set at liberty is titrated with a dilute solution of $Na_2S_2O_3$ of known strength, whereby the quantity of I liberated, and so the quantity of N_2O_3 concerned in its liberation, may be estimated. Further particulars may be found in *The Chemical News* for January 19.

REPLIES TO SCIENCE QUERIES.

A. W. B.—(*a*) A barometer tube is held vertically, and its open end is depressed below the surface of mercury. When the mercury inside the tube occupies $\frac{1}{7}$ of its length, the open end is 11 inches below the level of the mercury outside. When $\frac{1}{6}$ of the tube is occupied, the difference of level is 12 inches. Find the length of the tube and the height of the barometer.

(*b*) A fluid under pressure is contained in a tube of circular cross-section which varies in diameter at different parts of its length. Show that if the walls be of the same strength throughout, it is most likely to burst where the diameter of the cross-section is greatest.

(*a*) Let h denote the height of the barometer in inches, l the length of the tube, also in inches.

Due to the pressure h, the tube would be filled with air at atmospheric pressure. When the open end is depressed below the surface of mercury, the pressure on the enclosed air is increased, and is $h + 11$ when the open end is 11 inches below the surface. But we are given that $\frac{1}{7}$ of the tube is occupied.

Hence the equation becomes $h + 11 = \frac{7}{6}h + \frac{l}{7}$. . . (1)

In a similar manner, when the open end is 12 inches below the surface, we obtain the equation $h + 12 = \frac{6}{5}h + \frac{l}{6}$. (2)

The solution of these two equations will be found to give an impossible value for h. Hence we think you have either given the wrong data, or some error has found its way into the question. If, however, the latter part of the question be altered so as to read "that when $\frac{1}{6}$ of the tube is occupied the difference of level is 13 inches," then we obtain as before—

$$h + 11 = \frac{7}{6}h + \frac{l}{7} \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

$$h + 13 = \frac{6}{5}h + \frac{l}{6} \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

Simplifying, then dividing (1) by 5 and (2) by 6, we obtain

$$\frac{11}{5} - \frac{h}{30} = \frac{l}{35} \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

$$\frac{13}{6} - \frac{h}{30} = \frac{l}{36} \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

Subtracting (4) from (3),

$$\therefore \frac{l}{36 \times 35} = \frac{11}{5} - \frac{13}{6} = \frac{1}{30}.$$

$$\therefore l = 42 \text{ inches.}$$

Substitute this value for l in (3).

$$\therefore \frac{h}{30} = \frac{11}{5} - \frac{42}{35} = 1.$$

$$\therefore h = 30 \text{ inches.}$$

$\therefore$ height of barometer = 30 inches, and length of tube 42 inches.

(*b*) If p denote the pressure of the contained fluid, d the diameter of the tube, f the stress in the material due to the pressure p, and t the thickness of the tube, then the equation connecting these quantities is $p \times d = 2t \times f$.

$$\therefore f = \frac{pd}{2t} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

From equation (1) it will be obvious that p and t remaining constant, the stress, and therefore the tendency to burst, is increased when the diameter is increased: in other words, the stress, and therefore the tendency to burst, is directly proportional to the diameter.

The formula given is only true when the thickness of the cylinder is small compared with its diameter, but a similar result will be found to hold good in the case of a thick cylinder, and also when, instead of assuming the fluid at rest, it is in a state of steady motion. All the necessary formulæ can be obtained from any text-book on mechanics.

OUR COMPETITION PAGE

OUR FRENCH PRIZE COMPETITION.

Prize Editor—W. T. THOMPSON, B.A. (LOND.), *French and German Honours.*

RULES.

1. All translations should be **posted not later than March 8,** and addressed:—*Prize Editor*, Office of THE PRACTICAL TEACHER, 33 Paternoster Row, London, E.C.
2. Competitors should cut out and send the Coupon which appears on the Back Wrapper page of the current number.
3. Competitors should adopt a pseudonym, and send name and address written on a separate piece of paper.
4. No competitor may take the prize offered more than once in three months.

FRENCH PRIZE COMPETITION.

A Prize of One Guinea will be given for the best translation into English of the following extract:—

J'ajoutai le *don* à mon nom, imitant en cela bien des Espagnols roturiers qui prennent sans façon ce titre d'honneur hors de leur pays. Je me faisais donc effrontément appeler don Raphael, et me faufilai bientôt avec les principaux seigneurs, qui me présentèrent au grand duc. J'eus le bonheur de lui plaire. Je m'attachai à faire ma cour à ce prince et à l'étudier. J'écoutais attentivement ce que les plus vieux courtisans lui disaient, et par leurs discours je démêlai ses inclinations. Je remarquai, entre autres choses, qu'il aimait les plaisanteries, les bons contes et les bons mots. Je me réglai là-dessus. J'écrivais tous les matins, sur mes tablettes, les histoires que je voulais lui conter dans la journée. J'en savais une grande quantité; j'en avais, pour ainsi dire, un sac tout plein. J'eus beau toutefois les ménager, mon sac se vida peu à peu, de sorte que j'aurais été obligé de me répéter, ou de faire voir que j'étais au bout de mes apophthègmes, si mon génie fertile en fictions ne m'en eût pas abondamment fourni; mais je composais des contes galants et comiques qui divertirent fort le grand duc; et, ce qui arrive souvent aux beaux esprits de profession, je mettais le matin sur mon agenda des bons mots que je donnais l'après-dînée pour des impromptu.

LE SAGE.

RESULT OF THE FEBRUARY COMPETITION.

French.

The prize is awarded to "Brennus," the pseudonym of G. Brown, 11 Dalziel Place, Edinburgh.

First Class.—Fitzthomas, Manu forti, Carpe diem, Torridge, Polly, Atlanta, Français, C.E.M., Crockitwuds, Agaznog, Saniuqua, Madge, Gutiger, Kingston, Consuelo, Oliver Goldsmith, Marie (B), Chemineau, La cigale, Olivie, Dr. Dee, Paciencia, Marzavan, Marie (A), Dies, Majuba, Elise, Senrac, Reuben Butler, Kythé, Cygnet, Kettering, S.A.H., Imprimatur.

Second Class.—W.M.E., Shakespere, Callista, Jemima, Sculpin, Relenda, Roberts-Kitchener, Yemcie, Robin Hood, Rioghail, Percy Vere, Carr, Buffana, Hat, Ignota, Rutherford, Gipsy, Mumps, Josie, Thor, A.W., Maria, Novice, Dyad, Pleiades, Chrysolite, Kekewich, Sarnia.

Third Class.—Suspinul, Rosine, P. Bonde, Emma, Practical, Spes.

The following translations were received too late: Stella, Daffodil, Tartan.

Report.

The number of competitors this month is much below the average. We have often noticed this to be the case when the piece set is at all philosophical in tone, or deals critically with some great figure in French literary history. We are forced to the conclusion that the reading of many of our competitors is far too limited, both in quantity and in scope. Too large a number also have not a sufficient command of their own language to put any piece above the difficulty of an ordinary narration into good English. If we had space at our command, we could prove this by numerous instances from the batch of papers under review. The barbarism, "Montaigne wrote M. de Mesmes," perpetrated by several competitors, is a very venial fault compared with many mistakes we could select. The translation of *assiette* as "plate;" of *somme*, in the phrase *en somme*, both as "burden" and as "sleep;" and *il était arrivé au libre examen*, etc., by "He was not successful at an open competition for a very recent apprenticeship," are the chief curiosities of this month's competition.

French Prize Translation.

In 1570 Montaigne wrote to M. de Mesmes that, among the follies of poor humanity, one of the most notorious was that of employing the full vigour of our understanding in falling foul of and demolishing certain generally-admitted opinions; of aspiring to accept and entertain only those ideas whose worth had been tested over and over again in the crucible of the most subtle thought; of disturbing the steady and settled equilibrium of our soul, only in the end to fill it, after a long, weary quest, with doubt and disquietude.

Even if—though it is against all likelihood to think so—Montaigne did not remember a few years afterwards that it was only through a very recent apprenticeship that he had attained the full exercise of private judgment, yet he must at least have said to himself that he had advanced beyond the absolute scepticism of Pyrrho; that a man is no sceptic for voluntarily and frequently doubting many things; for distrusting immature, crudely-developed conceptions, shallow formulas, and mere theories, ambitious of explaining everything; for calling in question the validity of unverified statements; or for multiplying the precautions to be taken against error. Montaigne could not delude himself into scepticism. His doubts, and his motto, "What do I know?" did not hinder him from believing very firmly in many things with a whole-hearted, living faith, "de toute sa croyance." Abundant proofs of this faith exist, embarrassing only from the number of instances to choose from.

"BRENNUS."

Chemical Substances in Plants.—At the botanical garden of Buitenzorg, M. P. van Romburgh has been investigating the occurrence of chemical substances in plants. Acetone seems to be a widely-distributed substance. It occurs in *Hevea brasiliensis*, *Manihot glaziovii*, *M. utilissima*, *Phaseolus lunatus*, and many other plants. Methyl salicate is very widely distributed in the vegetable kingdom, and is recorded in many organs of many plants. The presence of hydrocyanic acid was determined in *Hevea brasiliensis*, *Manihot glaziovii*, the leaves of *Indigofera galigoides* and *Phaseolus lunatus*, and in smaller quantities in the leaves of many other plants.

Benzoyl Peroxide as a Bactericide.—Benzoyl peroxide is a white powder sparingly soluble in alcohol, glycerin, and fatty oils, and but slightly soluble in water. Frey and Vanino have discovered that it has great bactericidal power. The diphtheria bacillus is killed by it in fifteen minutes; *Streptococcus* in an hour and a half; *B. coli communis* in fifty minutes; *B. pyocyaneus* in fifteen minutes; *B. prodigiosus* in an hour; *B. proteus mirabilis* in twenty minutes.

The Dark and the Germination of Wheat.—In the *Revue Générale de Botanique*, J. Goldberg details some observations made on the germination of wheat. Proteid substances are formed in considerable quantities in the embryo in the dark. Since this phenomenon occurs at the close of the period of germination, it is clear that the formation of proteids does not take place at the expense of the decomposition of proteid substances which have passed from the endosperm by osmose.

(Several Competitors were disqualified this month under Rules 2 and 3.)

MR. MICHAEL E. SADLER ON EDUCATIONAL LIBRARIES.

ON February 14, Mr. Sadler addressed the members of the West Ham and District Educational Conference on the subject of "Educational Libraries." In a few prefatory remarks he explained that the wide range of the subject compelled him to concentrate attention on two or three main points, without thereby intending to disparage the importance of others not touched upon. And though his observations would necessarily be confined to books, it must always be remembered that books are far from being the only instruments of culture—least of all of a teacher's culture.

The Many-sidedness of an Educational Library.

The many-sidedness of the subject-matter of education would reflect itself in the composition of an educational library. In its wider sense, education is an aspect of life; not a bookish or separate thing, or a merely professional concern. The teachers' library, therefore, should be varied in its contents, reflecting all the higher interests of life. Especially should it be strong in books of poetry and imagination; in history, geography, and travel; in works accurately describing the beauties and wonders of Nature; in standard books on the life sciences; in biographies and autobiographies; in good fiction; and in essays, by ancient as well as by modern writers, on the conduct of life. It would be a misfortune to confine teachers' libraries to works on pedagogy. Education, even in its narrower and more professional sense, abuts on many other organised studies—for example, on hygiene, psychology, ethics, the history of religion, political philosophy, and social economy. Over these studies the teacher should, if possible, take a bird's-eye view, and with one or other of them many would desire to keep up by more detailed study. A selection, therefore, of the most representative works in each of these adjacent studies should find a place in a good teacher's library. Our work in education should be imbued with the spirit and in harmony with the methods of scientific, historical, and ethical studies of our time. In a teacher's private reading, stress would naturally be laid on those studies which were helping to formulate the aims of modern life. All true education implied an aim—an aim for the individual life and an aim for national effort. When these aims became blurred or faint, education slipped into muddle or drowsy routine. But when these aims were bravely defined, methods of education could be adjusted and improved accordingly. Life-aims should dominate education, just as in military operations the objective of the campaign determined strategy and tactics.

The Classification of an Educational Library.

A reference library, equipped for the systematic study of education, would naturally be divided into many departments. In any grouping of the books, it would be difficult to avoid some cross-classification; but the following was offered as a brief, tentative analysis of the main heads of such a library:—(1) History of Education; (2) Educational Biographies; (3) Organisation and Administration of Education; (4) Reports of Educational Commissions, and similar official documents; (5) Books on Methods of Teaching—that is, general manuals on the subject, or books dealing with teaching special subjects, such as history, geography, arithmetic, etc.; (6) Text-books, old and new, with a carefully-arranged antiquarian section; (7) School Architecture and School Hygiene; (8) Books on Hand and Eye Training, Art Teaching, Woodwork, etc.; (9) Books on Physical Education; (10) Special Books on the Education of Women and Girls; (11) Books on Kindergarten Teaching; (12) Books on Home Education; (13) Books on Commercial Education; (14) Books on various forms of Professional and Technical Education; (15) Books on Religious and Ethical Teaching; (16) Books on Education of the Blind, Deaf, and Mentally Deficient; (17) Educational Periodicals; (18) Educational Miscellanies—for example, pamphlets, articles from magazines, etc., bound in mixed volumes, but catalogued according to subjects; (19) Indexed Books, containing cuttings on educational subjects extracted from the daily and weekly press; (20) Selected Works on Psychology; (21) Selected Works on Ethics; (22) Selected Works on Political and Social Science; (23) Works of Reference, Dictionaries, Encyclopædias, Atlas, Calendars, etc.

Various Kinds of Educational Libraries needed.

Each town or group of schools should have a reference library of standard works on education. Such a collection would often find its most convenient place as a part of the local public library. Besides this, every teacher would naturally form a small collection of books on education. The lecturer emphasised the importance of a careful and repeated study of a few of the great educational classics, such as Plato's *Republic*, Locke's *Thoughts concerning Education*, Rousseau's *Emile*, and (if it might be included in such a list) Wordsworth's *Prelude*. He also dwelt on the value and interest of a comparative study of the educational ideals and systems of Great Britain, France, various German states, and America. A knowledge of French and German was essential to the systematic study of education, and well worth the labour of acquisition for that purpose alone. In addition to his private library and to the local reference library, a student of education would from time to time need access to some more specialised educational library. Such, in London, were the libraries of the Teachers' Guild, of the College of Preceptors, of the Parents' National Educational Union (in connection with which the lecturer referred to Mr. James Welton's *Critical List of Educational Works*), and of the Education Department. The special characteristics of these libraries were described. Allusion was also made to the special course in education now arranged by the National Home Reading Union.

Will there ever be a great Lending Library for Teachers?

In conclusion, the lecturer said that experience had shown him the need there was for some great central library from which any teacher in any type of school in Great Britain and Ireland might borrow, for use at home, expensive standard works required for the preparation of lessons in the various school subjects. Stimulating teaching depended on the range of the teacher's preparatory reading. But thousands of teachers were hampered in their work by the difficulty or impossibility of buying or borrowing the books to which they desired to refer in the preparation of their lessons. Was it possible that they might ever see the establishment of such a library, devoted to the needs of teachers of all ranks, and containing, as one of its departments, a comprehensive collection of British and foreign books, reports, and magazines on education? His ideal teachers' library would be housed in a beautiful building in some convenient place, and every teacher, responsibly introduced, would be entitled to membership, possibly on payment of a nominal subscription. The main work of the library would be to send out by train or parcel post, in answer to requisitions, parcels of standard books for the teacher's use at home. The organisation of this distributing agency would be on the lines adopted by the London library in St. James's Square, the usefulness of which is gratefully acknowledged by all students. The collection of books would include many copies of all the great standard works of reference in most frequent demand. Besides the distributing branch, he would have a reference library; and besides a large reading-room, several smaller chambers, which might be from time to time assigned (like the recesses in the Bodleian) to students engaged in some special work of educational research. One important task of the staff of librarians would be the preparation of catalogues of educational literature—especially subject-catalogues of British and foreign educational periodicals, in which were stores of experience now practically inaccessible. Attached to the library he would like to see a number of research studentships, to be given to teachers after a period of service, in order that they might visit foreign countries and report on their systems and methods of education. Furthermore, the trustees of such a library should publish reports and pieces of original work in educational research or observation, distributing such publications widely among schools. On the staff of the library should be some men and women themselves engaged in educational research, and competent to direct the investigation of the other workers, so that the whole work might move forward with economy of labour towards a precise aim. The lecturer was deeply impressed by the belief that in England especially there was need for more organised and combined research in educational science. He admitted that the establishment and maintenance of such a library as he had sketched would be extremely expensive, but he denied that the necessary outlay would be extravagant. The influence of such a library, and the labours of those engaged in its work, would do much to fertilise the whole field of national education. We needed the institution of carefully-planned educational experiments, the accurate record of their outcome, and the publication of their ascertained results. In this great work of scientific observation and experiment, the "permanent plant" of the suggested teachers' library and its advisory staff might play a chief, and indeed almost indispensable, part. But he was well aware that the ideal teachers' library which he had tried to describe was unlikely to be realised within the lifetime of those to whom he spoke.

REPORT OF EDUCATIONAL INSTITUTE OF SCOTLAND COMMISSION ON HIGHER EDUCATION.

In October 1897 it was agreed, on the motion of the late Dr. Ross, to instruct the Committee of the Institute on Higher Education "to devise means for obtaining a copious and authoritative body of evidence regarding the conditions under which secondary education in all its branches is carried on in the various districts of Scotland." This the committee resolved to do by means of deputations composed of members of the committee, who should visit various suitable centres. The aims and scope of their inquiries were very comprehensive—so comprehensive, indeed, as to embrace the whole range of Scottish education, from the elementary school to the higher or secondary school.

The Commission began its work on November 27, 1897, at Inverness, and extended its operations over the greater part of Scotland. During the preparation of the reports of these various meetings, the Commission has been exceedingly unfortunate. In the first place, the labours of the Commission were very seriously handicapped by the illness of Dr. Ross, to whose great energy and enthusiasm in the cause of Scottish education were mainly, if not entirely, due the inception and carrying out of the undertaking, and on whose shoulders the greater part of the work fell. Immediately following this, the death of Dr. Campbell, to whom had fallen no little share of the work, threw the work again behind. But even then it would appear that the misfortunes were not at an end, for lesser troubles ensued. So that it is only after many days and great difficulties that the report of the Commission appointed in 1897 now sees the light.

The committee, from their unique position, were able to elucidate very many important points with regard to Scottish education, so that almost all the conclusions arrived at in the report are the result of extensive inquiries and very full information, and, as such, are worthy of the attention of those educationists and legislators who seek to deal with education in Scotland.

Some of these points may be of interest to readers of The Practical Teacher, and accordingly we would briefly refer to the more valuable of these.

The Recognised Secondary Schools.

The result of the Commission's investigations with reference to the recognised secondary schools of Scotland proves that these can do the educational work of the country in a very limited degree. In parts of Scotland outside of populous centres it is impossible to plant, with any hope of success, such schools, while even in large towns it is maintained that the funds available are in no way sufficient for their work. To maintain such schools it would be essential to obtain very large grants from Parliament; and even if such were obtained, the attendance would be so meagre that healthy existence would be almost out of the question.

The general opinion was, they found, "that means of access to all schools supported by public funds should be provided for deserving children in whatever rank of life."

Another phase of this question presents itself in the provision of higher departments in ordinary schools. In Scotland, higher education must always be obtained in the ordinary Board Schools. From the physical peculiarities of Scotland this must be so. The system of bursaries, in many places so abundant, while in other places more conspicuous by their absence, will not meet the necessities of the case. Moreover, parents are unwilling, and rightly so, to send their children to central schools, even with the bursary thrown in, inasmuch as the pupils would not be under proper control and management. The only solution of the matter seems to be the establishment of higher departments in all the ordinary schools, so that higher education may be placed within the reach of all pupils. This is especially necessary in the country districts.

The Co-ordination of Primary and Secondary Instruction.

The lack of co-ordination between the curricula of the elementary and secondary schools is a great defect in the present organisation of secondary education. The different method of classification adopted in these schools leads to the pupils who take advantage of them, either by means of bursaries or otherwise, being sometimes pushed forward too rapidly in some subjects, while in others they are made to mark time for months—in many cases for whole sessions. To meet this difficulty, it is argued that the creation of wider areas of administration is necessary. The Commission give the following as their general conclusion in this matter—namely, "That the curricula of different classes of schools should be so co-ordinated as to prevent loss of time to pupils in passing from one grade of school to another."

After dealing pretty exhaustively with the subjects of bursaries and the claims of ancient and modern languages, the report goes on to deal with the very important question of

Management.

Practical unanimity was found to exist on this question in all the centres visited. One controlling body for all grades and classes of schools is the means by which the evil of overlapping may be lessened, if not altogether abolished. The committee, in discussing the question of management, on the assumption that separate managing bodies should be continued, were met by different opinions. Some favoured the idea of forming boards of management for higher education, chosen from local bodies interested in education. Others favoured election *ad hoc*. Some were of opinion that the work should be entrusted to County Councils.

The findings of the Commission on the subject are:—

1. That there should be a uniform system of management for all classes of schools.
2. That it should embody boards to manage areas large enough to include all classes of schools required in the various areas, with a central regulating board, subject to the control of the Scotch Education Department.
3. That the board should be directly representative of the ratepayers of their districts.
4. That they should have power to tax for all educational work required in their districts.

The question of grants in aid of higher education, together with the administration of these funds, is dealt with at some length, and will prove of great value to the educationist and legislator.

With regard to the government of education by the issue of various minutes, the committee are strongly of opinion that departmental minutes, however wisely and skilfully framed, can never put Scotch education on a proper footing. What is required, and urgently required, is an Act of Parliament dealing with every phase of education.

The report, we feel convinced, will amply repay careful perusal and study. We have not dealt with the evidence as given at the various centres, but rather with the general conclusions arrived at by the committee. The report contains a mass of very valuable information—authoritative and up to date.

The Commission are to be congratulated on the result of their labours, and our only regret is that the report was not issued sooner.

Copies of the report are on sale (2s. 6d.), and may be obtained from the Educational Institute headquarters.

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Liquid Hydrogen and the Germinative Power of Seeds.—Some interesting experiments have lately been made by Sir W. T. Thiselton Dyer on the influence of the temperature of liquid hydrogen on the germinative power of seeds. Barley and wheat were taken together with the vegetable marrow, pea, and musk. These seeds, certified of good germination, were sealed up in a glass tube cooled first in liquid air and then transferred to hydrogen. In this way a temperature of −250° C. or −252° C. was reached, and maintained for half an hour, and later for an hour—another set of seeds being cooled only in liquid air for comparison. On opening the tinfoil packages in which the seeds had been wrapped, they were found to be fresh and bright. They were sown in a cool greenhouse without heat on the twenty-seventh of July. On the first of August they had all germinated. Professor Dyer then had a packet of seeds cooled without graduation of cooling, and actually immersed in liquid hydrogen for upwards of six hours. The temperature reached was −453° F., below melting ice. These seeds germinated without exception. It would seem that even at low temperatures the thermal capacity of at least the seed coats may be considerable.

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First Exercises in Latin Prose Composition. By E. A. Wells, M.A. This little book, by an old pupil of Dr. Abbott of the City of London School, has rather long vocabularies to be learned by heart. The exercises, which consist of short English sentences to be turned into Latin, are well chosen, and not too long. On the whole, it may be considered a useful little first book for Latin prose in the hands of a good master. For the private student it is not so suitable as books containing more examples. A serviceable feature for beginners is the general vocabulary.

C. Julii Caesaris De Bello Gallico, III. Edited by F. H. Colson, M.A. This little volume forms one of Bell's Illustrated Classics, a very well edited and clearly-printed series for schools. There is a good introduction on Cæsar as a writer and general, on the conduct of the Gallic War, especially the campaigns of the Third Book, and on the Roman army. The notes, which are clear and not too long, explain difficult grammatical constructions, and are supplemented by appendices on subordinate sentences, the ablative absolute, the gerund and gerundivé, some uses of the genitive case, some uses of the dative case, and on related words and prefixes. The illustrations, which are very good, include a bust of Cæsar, the plan of a Roman camp, Roman ships, a sea fight, the Agger being advanced against a town, a map of Gaul, and plans of Galba's operations in the Alps and the operations against the Veneti. There are an index of proper names, with references to the text, and a complete vocabulary.

Horace: Odes, Book I. Edited by C. G. Botting, M.A. This edition of the First Book of Horace's *Odes* is intended for the private student, as well as schoolboys. The notes give a good deal of help in translation, and contain modern illustrations from various sources—for example, i. 4, v. 13; and parallels—for example, xxviii. 3, xxxvii. 21. The notes and the index of proper names are designed to make the use of a classical dictionary unnecessary. An appendix of grammatical constructions treats of the prolative infinitive with verbs and with adjectives, hendiadys, the Latin imitation of the Greek Middle, the dative with passive, the twenty-eighth ode and metrical irregularities. Other features of the book are a short life of Horace, a description of the metres used in the book, and a complete vocabulary.

Hannibal's First Campaign in Italy. Livy, XXI. 39-59. Edited by F. E. A. Trayes, M.A. The text of this history of the Second Punic War is mainly that of Müller in Trubner's Series. In the notes the commentaries of Weissenborn and Wölfflin, Dimsdale and Capes, have been drawn on, while Brambuch and Buck have been followed in matters of orthography. The text is clearly printed, contains a short analysis, and is illustrated by a good map of Italy and drawings of a fortified camp, a bridge of boats and fort, a bridge of rafts, a plan of the battle of the Trebia, etc. An introduction treats briefly of the life of Livy, his history and its characteristics, other authorities for the Second Punic War, and the translations of Holland and George Baker. The notes are concerned with English renderings and grammatical construction. There is an appendix of critical notes, and another on the battle of the Trebia. A short grammatical index contains the principal constructions referred to in the notes, and there is a historical index of the more important proper names.

P. Vergili Maronis Aeneidos Liber Secundus. Edited by L. D. Wainwright, M.A. The notes in this little book occupy more pages than the text, and though they are clear, and deal mostly with questions of translation and grammatical construction, it would have been better to shorten them by a separate analysis of the wanderings of Æneas and a list of modern instances and parallels. There is a very short appendix on the use of verbs passive in form in the sense of the Greek Middle, and a grammatical appendix of references to the notes. The introduction is taken up with the life of Vergil, some account of his works, metre, and translations. There are an index of proper names and a complete vocabulary.

P. Vergili Maronis Aeneidos Liber Quartus. Edited by A. S. Harman, B.A. This little book is intended for lower forms in schools. A brief introduction gives the chief facts of Vergil's life, some account of his works, a brief outline of the story of the Æneid, specimens of translations, and notes on metre. An analysis of the Fourth Book is incorporated with the text. The notes are brief and clear, and there is an appendix of grammatical peculiarities.

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The Odes of Horace, Book IV. Edited by Stephen Gwynn, late Scholar of Brasenose College, Oxford. This little book is designed for junior students. The Carmina are clearly printed, and the notes explain grammatical difficulties and historical allusions in a small compass. There is an appendix on metres, and Sir Stephen de Vere's translation of Ode VII. is given. The introduction is concerned with the life of Horace, and there is a complete vocabulary.

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Gai Juli Caesaris De Bello Gallico, Liber V. Edited by E. S. Shuckburgh, M.A. This little edition of the Fifth Book of the Gallic War contains a description of the events of B.C. 54, a list of the principal dates in Cæsar's life, a clear map, an analysis incorporated with the text, notes, and a vocabulary. There are a few illustrations, the notes are historical and grammatical, and references are given to the *Revised Latin Primer*.

The Æneid of Vergil, Book V. Edited by A. Sidgwick, M.A. This is another volume in the Cambridge Series for Schools and Training Colleges. The notes and introduction are abridged from Mr. Sidgwick's larger edition of *Vergil*. There are a note on metre and a complete vocabulary. There are no illustrations.

Ovid: Selections from the Tristia. Edited by H. F. Morland Simpson, M.A. This selection from the *Tristia* contains the chief incidents of Ovid's life. An analysis is incorporated with the text. The notes are sufficient and well arranged. The vocabulary includes proper names. Maps and illustrations would have made the book a brighter one for young students.

Xenophon: Anabasis, V. Edited by G. M. Edwards, M.A. This is a useful little edition of the Fifth Book of the *Anabasis*. The introduction contains sections on the early life of Xenophon, Cyrus and the Greeks, Xenophon, Proxenus, and Cyrus, the *Anabasis*, and the later life of Xenophon. The text is clearly printed and analysed. The notes are clear and not too elaborate. There is a list of non-Attic words. The vocabulary is followed by an index of proper names and a grammatical index. For illustrations there is a map showing the route of the Ten Thousand.

The Expansion of the British Empire, 1500–1870. By William Harrison Woodward. This book, by the Principal of the University Training College, Liverpool, is intended to be not a digest of the general body of facts that relate to colonial history, but a narrative illustrating the broad underlying principles which from time to time have governed British expansion. The book is well arranged and clearly written. There are a good list of readily accessible works of reference, a table of dates, and a summary of the chief British possessions, with the dates and manner of their acquisition. The maps, which are very good, comprise a general map of the British Empire in 1899; Frobisher's map, 1578; New England, 1620–1650; India, *circ.* 1785; Northern New France and the British Colonies, 1750–1760; and India, 1805. A map of special interest at the present time is that of British Africa in 1899. It is a pity that this useful little book has not a list of original sources.

Macaulay's Essay on Milton. By J. H. Flather, M.A. A very serviceable little edition of Macaulay's first contribution to the *Edinburgh Review*. The introduction contains the life of Macaulay, a brief criticism on the Essay, a note on Johnson's *Life of Milton*, English politics in 1825, and Macaulay's style. The notes are adequate and clear.

The Pitt Press Shakespeare.—As You Like It. By A. W. Verity. Of the many school editions of Shakespeare's plays this is certainly one of the very best. Everything possible has been done to make the young student understand and appreciate the tale, and at the same time to estimate its value as a literary production. The extracts given from Lodge's *Rosalynde* practically present the tale in prose, and might well—as the editor suggests—be utilised as a separate reading lesson.

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Latin Course, First Year. By W. Wallace Dunlop, M.A. This little book contains grammar to the end of the regular verbs, and carefully graduated exercises which are placed at the end of the book. The simple rules of syntax are introduced as they are required for translation. It is a clear and workable little book.

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Elementary Algebra. By C. H. French, M.A., and G. Osborn, M.A. This volume contains a treatment of the subject, up to the end of simultaneous quadratic equations and problems connected therewith, which is more complete, and on the whole more helpful to a beginner, than any with which we are acquainted. The authors, who have gained their experience as teachers at the Leys School, claim, and justly, that the most distinctive feature of their work is the simplicity of its language. They are convinced "that the text itself of ordinary algebras is hardly ever understood," and that "most pupils have too little knowledge of English to profit by them, and are both mystified and repelled by sentences containing a number of polysyllabic abstract terms." The result of their endeavours to confine their "vocabulary, as far as possible, to short or familiar words, trying to avoid technical terms," is a book unique in its suitability for the private student, and at least as suitable as any in the market for school use, and much more suitable than any we know for the use of a teacher who expects his pupils to read the text of the book which he adopts. We agree with the authors that "no one fit to begin algebra will find the bookwork beyond his comprehension," even without a teacher's help.

There is no great novelty of treatment; indeed, our authors have been unnecessarily apprehensive of "the charge of unjustifiable innovation." A welcome change is the relegation of all examples—which are unusually numerous—to the end of the chapter, "so as not to have them on the same page as the bookwork." We should welcome the change even more if the examples were at the end of the book.

We have but few criticisms to make, and we admit that these are in the main matter of private opinion. We deprecate the omission of the method of detached coefficients. Seeing that all pure arithmetic is a series of examples in illustration of this method, the omission strikes us as the loss of an opportunity to insist upon algebra as generalised arithmetic. To the authors algebra differs from arithmetic mainly as introducing the conception of negative number (page xi). To us it seems that the stress should rather be laid on algebra as the science of continuously varying magnitude. In the factorisation of the difficult case of $ax^2 + bx + c$ the simplest rule is not given, but recourse is had to a tedious system of trial cases. The best rule is to determine two numbers whose product is ac and whose sum is b, and from these numbers the correct factors follow at once. Thus, with $2x^2 + 9x + 4$, we begin by determining two numbers whose product is 8 and whose sum is 9—namely, the numbers 8 and 1. The factors are now found at once *without any trials*. Such a process would solve at once the equation $12x^2 + 5kx - 72k^2 = 0$ (page 263) without employing the often terribly tedious process which is explained. The statement at the top of page 136 is dangerous as it stands, and still more dangerous in connection with the examples which illustrate it (XV. i., Ex. 8, 11); for if the pupil is informed that $x^4 + y^4$, $a^4 + b^4$, $x^4 + 16$ "have no factors," he will certainly infer that $x^4 + 4$ has "no factors," and overlook the factors $x^2 + 2x + 2$, $x^2 - 2x + 2$, to which the factorisation of $x^4 + x^2y^2 + y^4$, treated differently from the method given, might have led him. We confess, too, that we doubt the educational soundness of the axiom which has guided our authors in the choice of their examples—that it is "not desirable to expect anything of the nature of original work from beginners"—and which has led them, therefore, to include in the examples "very few for which no instruction has been given." On the contrary, we incline to think that there is grave danger nowadays of providing beginners with too much help, and that—we quote our authors' self-condemnation—"to some minds

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The Preceptor's Trigonometry. Edited by W. Briggs. This work consists of excerpts from the larger *Tutorial Trigonometry*, by Messrs. Briggs and Bryan, which we reviewed some months ago in these columns. We described the larger work as "a thoroughly good work on somewhat old-fashioned lines," in which "the sign-manual of experienced teachers is written on every page in the 'Cautions,' and 'Notes,' and 'Summaries.'" The present selection includes, in the order named, sexagesimal and circular measures; identities involving one angle; equations; logarithms; solution of triangles, heights, and distances; trigonometric functions of sum or difference; multiple angles; identities and equations involving several angles; inverse functions; and related circles. The teacher will note the admirable way in which the first fifteen chapters are confined to the trigonometry of one angle, by deferring the "addition theorems" until after triangles have been mastered. The chief defect in the book is the lack of examination papers and miscellaneous exercises. Nevertheless, it is only fair to add that the examples appended to each chapter are numerous and admirably graded. For the purposes of the Junior Local Examinations, and for the Preceptors' Examinations, we have not met with a work which, on the whole, seems more satisfactory.

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Freehand: County Council Scholarship Series. By H. W. Clarke, Art Master, London School Board. (Four sets of twelve copies.) These are sets of freehand drawing made up on the lines of the old Second Grade (or elementary course) of the Science and Art Department. They meet the requirements of those candidates who intend sitting for the County Council, University Local, and College of Preceptors examinations, but no method is shown as to the planning-out of the examples. Each set is printed in grey outline, and contains examples of more or less difficulty. Although some of the turn-over leaves require more careful attention to the details of drawing, and some of the entomological studies are likely to give students some troublesome times through their complexity, yet the sets will no doubt be found useful to scholars in the upper standards.

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General Intelligence Papers. By Gerald Blunt, M.A. We cordially recommend this book to the notice of our readers. It is unique, and it is valuable. The tendency of the present age to set for all examinations a detailed syllabus of study, while serving, perhaps, to render the knowledge in those particular subjects more definite and precise, prevents to a large extent that general reading—that "browsing of literature"—which is so essential in the full education of every one. The successful "passing" of an examination is too often held up to young students as the goal of their ambition, when surely they should be taught to aim at an all-round perfect development. Mr. Blunt, the head-master of a good school, has done well in reminding us of this by issuing these examination papers in what he terms "General Intelligence." With his prefatory remarks we entirely agree, and we would recommend their perusal to all teachers.

As to the scope of the questions given, there may be some difference of opinion; but, on the whole, attention is directed to those topics and allusions which every well-read man must know.

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3. Where are the following, and how are they remarkable?—Gretna Green, Salt Lake City, Goodwin Sands, Paul's Cross, Amen Corner, Bridge of Sighs, Isle of Dogs, Chiltern Hundreds.
4. Explain the following phrases:—A crumpled rose-leaf; a round robin; a stalking horse; a lotus eater; a white elephant; a man of straw; a bear garden; a vampire.

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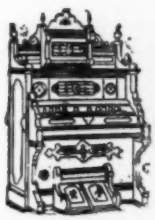

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Other sections provide outline essays on subjects in the animal, vegetable, and mineral worlds, geographical and historical, and miscellaneous subjects: for example, Uses of Steam—Skeleton Story—Travels of a Letter—A Winter Day—Three Famous Bridges—Autobiography of a Penny—Man the Lifeboat—Modes of Travelling: Then and Now—Our Town or Village—Some Celebrated Lighthouses—The Fire Brigade—Cricket—Walk in Summer—Daily Paper—Football—Ships—Weapons: Old and New—An Assize Court—Through Prison Bars, etc. Each set of notes is accompanied by appropriate and well-chosen illustrations of the chief points. Such rules on punctuation, use of *who* and *whom*, *who*, *which*, and *that*, letter-writing, etc., as can be given to children without confusing them, are added.

The book can hardly be called an "addition" to the literature on the subject, since, as far as we know, it is the only attempt to set about the subject in the absolutely best manner.

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A FAITHFUL DOG.

(Written by a boy of ten.)

It was winter-time, and a little girl about eight or nine years old saw people skating on the river, so she thought she would like to do the same. After she had got permission from her mother, she started to the river, with her faithful dog Carlo. When she reached the river, there was no one there; but she would not go home without having a slide. She got on all right, until all at once there was a loud crack, and she found herself in the water. Directly Carlo saw what had happened he rushed off for assistance. Presently he came to a forest, when he saw a lumberman at work. He ran to him as fast as he could, and catching hold of him by the trousers, he told him (as best as he could) what was the matter. The woodman then left his work and followed Carlo. Very soon they reached the place where it had occurred. Carlo stood on the bank looking on, while the woodman wended his way over the ice to where the little girl lay. When he reached the place where she was, he pulled her out by the arm. She thanked him for his kindness, and he took her home to her parents, where he received their very best thanks. He then went back to his work.

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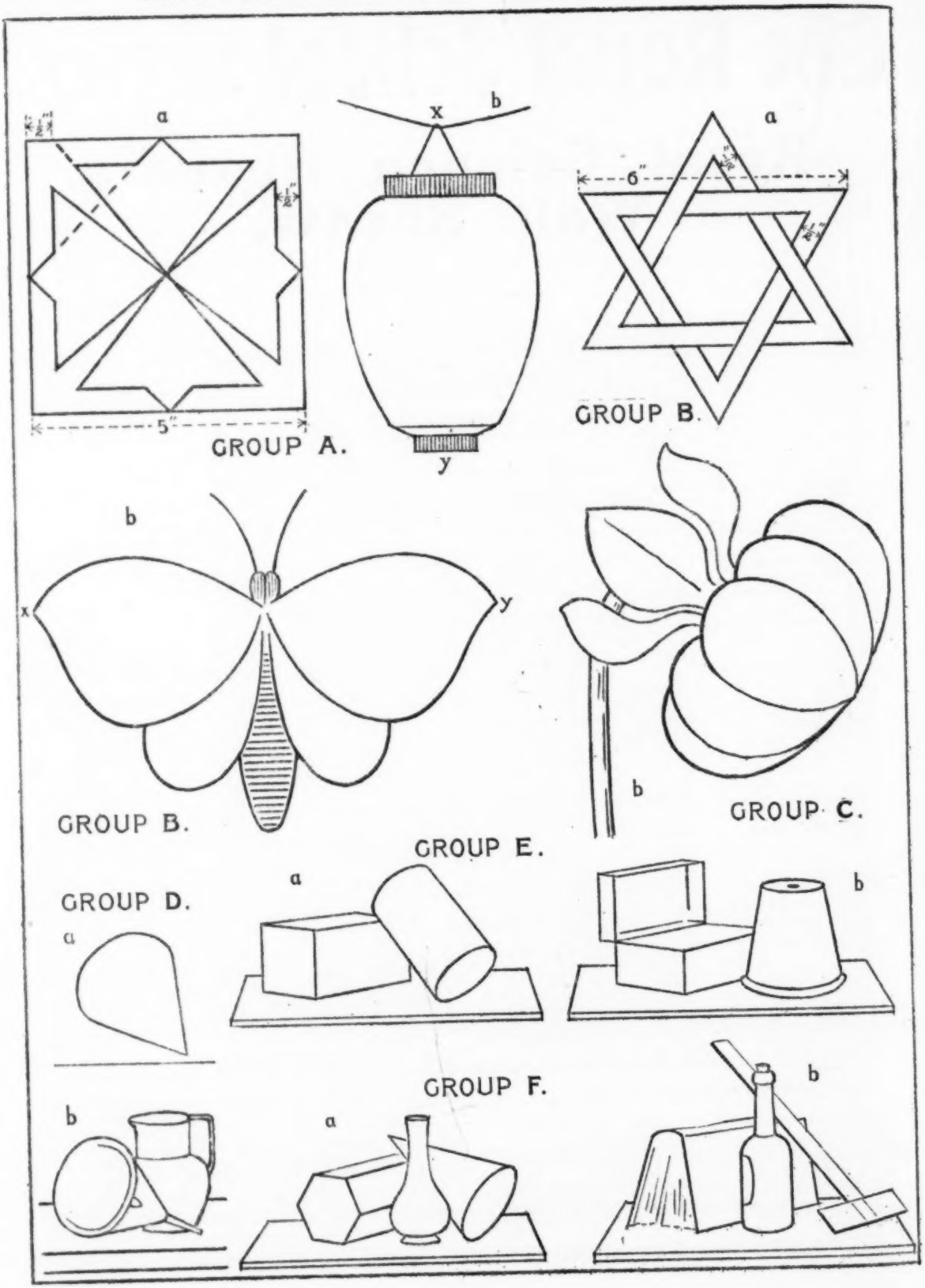

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THE WORK TO BE DONE. (For Illustrations, see preceding page.)

Group A.—1. Draw *a* as a *ruler drawing* to the given dimensions.

2. Draw *b* as a freehand drawing—*xy* being about 6 inches long.

Group B.—1. Draw *a* as a ruler drawing to the given dimensions.

2. Draw *b* as a freehand drawing, having *xy* about 6 inches long.

Group C.—1. Draw a common school ink-well to a scale of 3 inches to 1 inch.

N.B.—A neatly-constructed scale must be drawn on each paper.

2. Draw *b* as a freehand drawing, about 9 or 10 in. high.

Group D.—1. Draw the ordinary cone with the apex turned towards the spectator, as shown in the sketch.

2. Draw a common funnel and pitcher, placed as shown in the sketch.

In the above groups the two drawings must be on *one sheet of paper*, and on the same side of it.

Group E.—Draw the group of models shown at *a* **or** *b*, and the board supporting them.

Group F.—Draw the group of models shown at *a* **or** *b*, and the board supporting them. A vase, pitcher, or other similar object may be substituted for the bottle in *b*.

In Groups D, E, and F the drawings should well fill a paper 15 inches by 11 inches.

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